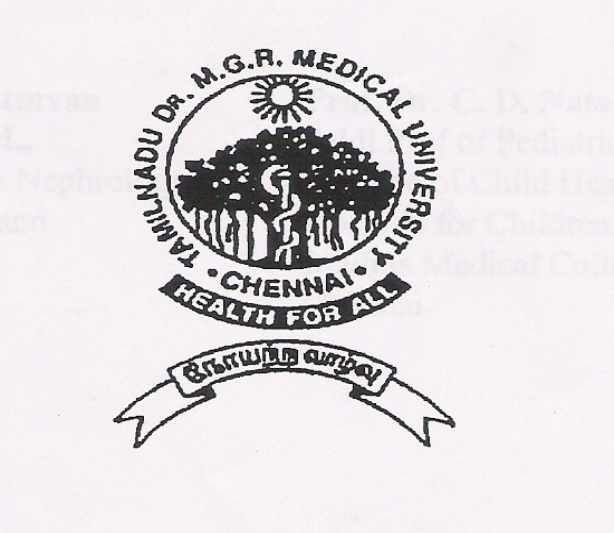
ANTHROPOMETRY DATA FOR ADOLESCENT SCHOOL GOING CHILDREN AND STUDY ON SEXUAL AND MENSTRUAL AWARENESS IN CLASS XI AND XII STUDENTS



DISSERTATION SUBMITTED FOR
MD DEGREE IN PAEDIATRICS
DR.M.G.R. MEDICAL UNIVERSITY, CHENNAI
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CERTIFICATE

This is to certify that the study on **Anthropometry data for Adolescent School Going Children and Sexual and Menstrual Awareness in Class XI and XII students** is a bonafide work done by Dr**. A. Devi**, post graduate MD student of department of Child Health, Christian medical college, Vellore in partial fulfillment for the award for MD (Branch VII-PEDIATRICS) degree of The **Tamil Nadu Dr. M.G.R. Medical University,** February 2007.

Guide

Dr. Leni Grace Mathew MD, DCH, MRCPCH

Professor and Ag Head, Child Health unit-1

Christian Medical College, Vellore

Head of the Department of Child Health

Dr. A.K Jana MD, DCH

Professor and Head of Child Health

Christian Medical College, Vellore.

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Table of contents:

INTRODUCTION

Adolescence, a period of transition between childhood and adulthood, occupies a crucial position in the life of human beings. This period is characterized by rapid changes in body size, shape and physiology as well as psychosocial functioning. The exceptionally rapid rate of growth during this time is due to pubertal growth spurt There is much individual variation in timing and degree of pubertal growth due to nutritional status and ethnic, cultural and social differences [1,2] .

Child growth is a very sensitive indicator of his or her health and nutritional well being [3]. It is also a marker of the country's public health status. The improvement in socio economic circumstances and the general health of communities will normally be reflected in the improved growth of its children over the years. Normal growth is an indicator of the overall well being of a child. Assessing the growth of children is important for judging their overall progress at both population and individual levels. Growth measurements are relatively simple and inexpensive to make, although important training is required to obtain good quality measurements. Due to differences in height and weight of normal people of different ethnic groups, each country should have its own growth standards against which to evaluate children [4].

Most countries have their own Growth charts for the preadolescent children. However, very little is known about the nutritional status of adolescents in both developed and developing countries. One reason is the lack of an internationally agreed method for assessing nutritional status during this period of life. As in other stages of the life cycle, in adolescence nutritional status is best assessed by using anthropometric measurements. However, the assessment of under and over-nutrition during the adolescent period is complicated by important changes in body composition, in particular during the puberty related growth spurt. As a result, much less is known about anthropometry in adolescents than

in younger and older age groups. Rapid changes in somatic growth, problems of dealing with variations in maturation, and the difficulties involved in separating normal variations from those associated with health risks have deterred the gaining of scientific knowledge relating adolescent anthropometry with determinants and health outcomes [5].

In 1977, the National Center for Health Statistics (NCHS), which is now a part of Centers for Disease control and prevention (CDC), developed growth reference charts that were based for the first time on representative samples of the population of the United States. The 1977 NCHS reference growth charts were constructed for children ages 2 to 18 years of age, using data collected from 1963 to 1974.

In 1978, the CDC modified the 1977 growth reference charts to improve their use. The international version of the reference was published by WHO in 1979 and was revised four years later to create the 1983 WHO Reference growth Charts. In May 2000 the NCHS/CDC released revised reference growth charts for the United States and this has been accepted as the data better representing racial and ethnic mixture of growth charts[6].

There are lots of studies done in India right from 1941 but the landmark study was the ICMR study done in 1972 for children aged 0 to 21 years [7]. Similarly Agarwal study was done in 1992 in affluent Indian children from 5 to 18 years of age of NCHS[8]. However no standardized charts are available which can be used for all children.

Menarche is recognized as a crucial time in a girl's physiological, psychological and social development. Biologically, menarche is an important life event for a girl; it follows the year of her maximum growth spurt as well as development of breasts and pubic hair and changes in body contour[9]. Psychoanalysts have written of menarche as an important time in woman's identity formation as she

moves toward acceptance of herself as a female and as a future mother [10,11]. The appearance of blood at menarche may provoke ideas of genital injury and reactivate childhood sexual conflicts, fears, and anxieties[10,12]. The fears and anxieties are attributed to lack of preparation in terms of factual knowledge. Studies on effect on menarche and attitude toward menstruation in the adolescent age group clearly showed that those with prior knowledge coped better and had a healthier attitude toward this important event in a girl's sexual development[10]. Due to various cultural beliefs and religious barriers, this topic is seldom studied in our country.

In a country like ours, where sex education is not routinely included in high school syllabus, most adolescents gather information from friends and media. Often this information is wrong and unscientific. Therefore, youngsters, driven by their curiosity about their own sexuality and that of the opposite sex, are likely to go astray. With high prevalence of STD and HIV/AIDS in our community, there is rising rate of morbidity due to sexual ignorance, poor decision making, and inadequate sex education[13]. Studies on the effects of sex education in schools show that sex and AIDS education often encourages young people to delay sexual activity and to practice safer sex, once they are active[13,14].

Need for the Study:

The United Nations sub Committee on Nutrition meeting held in Oslo in 1998 concluded that more data on health and nutrition of school age children are needed to assess their scale of problem[2, 15-18]. It also believed that the scale of nutritional problems might have been previously under estimated. Traditionally the main health indicator used by health planners has been mortality rates. Adolescents have the lowest mortality among the different age groups and therefore have received low priority[2, 15-18]. However recent studies have shown that the prevalence of malnutrition and anemia is high in these age groups [2, 15-18]. Previous data like ICMR study[7] was done among poor patients and the Agarwal study

was done among affluent children [8].

Studies from our Department were done more than a decade ago, for age group 0-5 years and the present growth chart we is only upto 12 years. There is no growth charts available for 12 to 18year age group. The currently available CDC and Agarwal charts may not be representative of our population since those were based on affluent urban population, Moreover, there has been considerable change in the socio-economic and health status in our community. Hence we decided to go through this exercise to construct growth charts for the adolescent population in our town.

The present study is being done with the objective of assessing the height and weight of adolescent children attending schools in Vellore town and thus to develop a growth chart for children between 12 to 18 years. We also plan to study the attitude of girls towards menarche and sexual awareness among adolescent school going children. This will be used as baseline information to plan and initiate an on going school counseling program on adolescent health education.

REVIEW OF LITERATURE

'Adolescence' is the French word derived, from 'adolescere', which means growing up. It is the age group of 10 to 19 years. The bridge between the childhood and the adulthood is adolescence. The beginning of adolescence is known as 'puberty.' It is marked by menarche (first menstruation) in girls, which generally occurs between the age of 11 and 13 years; and by first nocturnal emission (wet dream) in boys, which generally occurs between the age of 12 and 14 years. The period of growing up is of about 4 years. Girls become mature at an early age than boys. There are physical as well as psychological changes and physical changes precede psychological changes[13].

***WHO Definition of Adolescence*:** WHO defines the adolescent age range as the second decade of life,

10-19 years. However, it must be recognized that adolescence is a combination of physical, psychological and social changes, which are culturally based[19].

ADOLESCENT GROWTH

During puberty Biological, psychosocial and cognitive changes occur. These changes directly affect nutritional status and nutrient needs. Adolescents also experience significant changes in their ability to assess and comprehend complex situations and information and in their desire to become independent, unique individuals. Therefore, it is vital to have a thorough understanding of adolescent physical and psychosocial growth and development.

Optimal growth depends on genetic constitution, normal endocrine function, adequate nutrition, absence of chronic disease, and a nurturing environment. Fetal, infant, environmental, and maternal factors can interact to impair intrauterine and postnatal growth[20]. Observed genetic differences in birthweight among various populations are small and although there are some racial/ethnic differences in growth, these differences are relatively minor compared to worldwide variations in growth due to health and environmental influences (i.e., poor nutrition, infectious disease, socio-economic status) [21,22.] Few ethnic differences in weight and growth of infants and children would remain if they all lived in a similar environment and received the same optimal nutrition and care [5, 21,23].

Normal Physical Growth and Development

The beginning of biological growth and development during adolescence is signified by the onset of puberty. A series of biological changes occur during puberty including sexual maturation, increases in height and weight, completion of skeletal growth accompanied by a marked increase in skeletal mass, and changes in body composition. The succession of these events during puberty is consistent among adolescents, however, there is a great deal of deviation in the age of onset, duration, and tempo of these

events between and within individuals. For this reason, adolescents of the same chronological age can vary greatly in physical appearance. This has direct relevance for the nutrition requirements of adolescents. Consequently, sexual maturation should be used to assess the extent of biological growth and development and the individual nutritional needs of adolescents in place of chronological age. Sexual Maturation Rating (SMR), also known as Tanner Staging, is based upon a scale of secondary sexual characteristics that permits health professionals to gauge the degree of pubertal maturation that has occurred among

adolescents, regardless of chronological age (Table 1). SMR is based on the appearance of pubic hair, the development of breasts, and the occurrence of menarche among

Table 1

Sexual Maturity Rating

GIRLS

Breast Development	Stage	Pubic Hair Growth
Prepubertal; nipple elevation only	1	Prepubertal; no pubic hair
Small, raised breast bud	2	Sparse growth of hair along labia
General enlargement of raising of breast and areola	3	Pigmentation, coarsening and curling, with an increase in amount
Further enlargement with projection of areola and nipple as secondary mound	4	Hair resembles adult type, but not spread to medial thighs
Mature, adult contour, with areola in same contour as breast, and only nipple projecting	5	Adult type and quantity, spread to medial thighs

BOYS

Genital Development	Stage	Pubic Hair Growth
Prepubertal; no change in size or proportion of testes, scrotum and penis from early childhood	1	Prepubertal; no pubic hair
Enlargement of scrotum and testes; reddening and change in texture in skin of scrotum; little or no penis enlargement	2	Sparse growth of hair at base of penis
Increase first in length then width of penis; growth of testes and scrotum	3	Darkening, coarsening and curling, increase in amount
Enlargement of penis with growth in breadth and development of glands; further growth of testes and scrotum, darkening of scrotal skin	4	Hair resembles adult type, but not spread to medial thighs
Adult size and shape genitalia	5	Adult type and quantity, spread to medial thighs

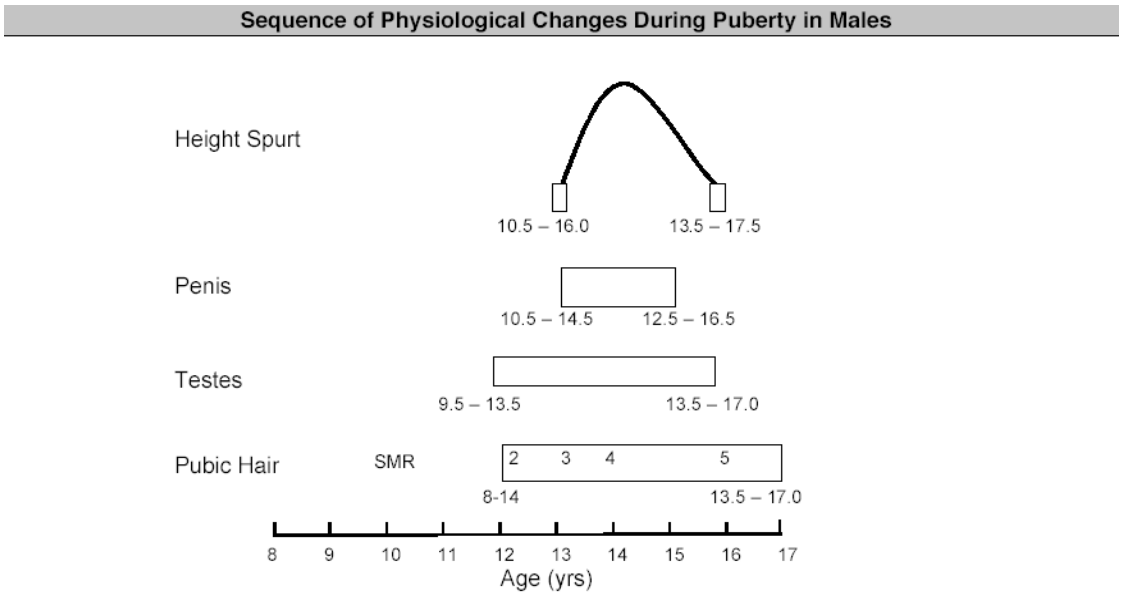
Source: Data from Tanner JM. Growth at adolescence. Oxford: Blackwell Scientific Publications, 1962.

females; and on the degree of testicular and penile development and the appearance of pubic hair among males. SMR stage 1 corresponds with pre-pubertal growth and development, while stages 2-5 indicate the progression of puberty. By SMR stage 5, sexual maturation has been completed. Sexual maturation correlates remarkably well with linear growth, changes in weight and body composition, and hormonal changes[24].

Figure 1 depicts the occurrence of the linear growth spurt and the onset of menarche relative to the occurrence of secondary sexual characteristics among females during puberty. The first signs of puberty among females are the development of breast buds and sparse pubic hair, which occurs between ages 8-13 on average (SMR stage 2). The onset of menstruation occurs 2-4 years after the initial appearance of breast buds and pubic hair, usually during SMR stage 4. The average age of menarche is 12.4 years for females in the United States, but the age at which it occurs is highly variable; menarche can occur as early as 9 or 10 years of age or as late as 17 years of age. The onset of menstruation may be delayed in females who restrict their caloric intake and body weight or who are competitive athletes.

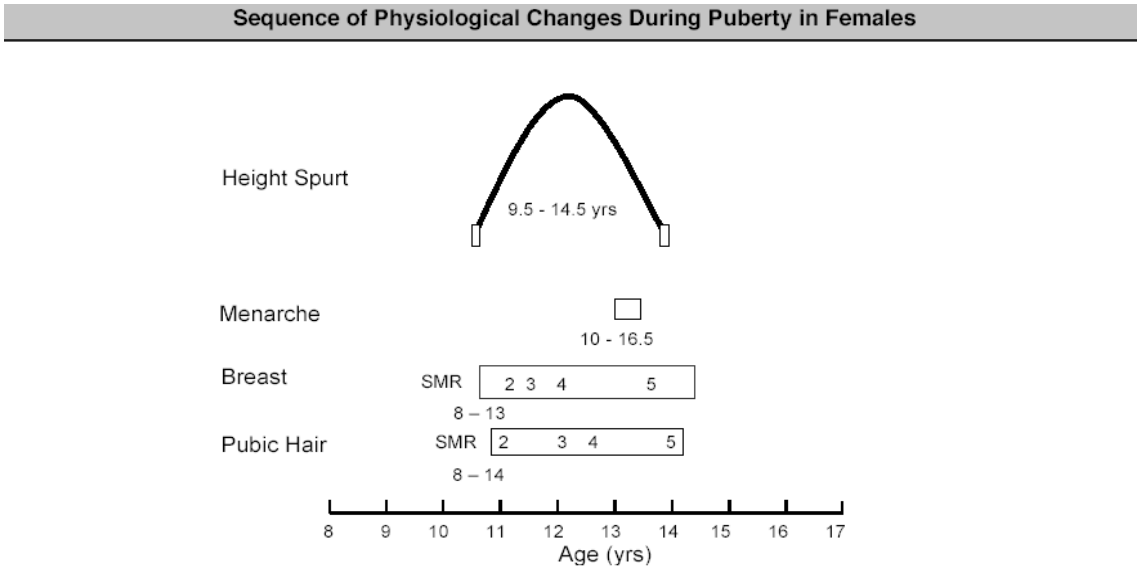
Testicular enlargement and change in scrotal coloring are the first signs of puberty among males, usually occurring between 10.5 and 14.5 years of age (11.6 on average) during SMR stage 2 (Figure 2). The development of pubic hair is also observed during SMR stage 2. Testicular enlargement starts between 9.5 and 13.5 years of age in most males (SMR 2 to 3), concluding between the ages of 12.7 and 17 (SMR stage 5). Spermarche, or the onset of sperm production, occurs at approximately age 14 among males. The onset of puberty among males is highly variable, thus nutritional needs of male adolescents of the same chronological age are also highly variable.

The linear growth spurt begins most commonly during SMR stage 2 in females, between 9.5 and 14.5 years of age. Peak velocity of linear growth takes place at the end



An average male is represented: the range of ages within which each event charted may begin and end is given by the figures placed directly below its start and finish.

Fig 1



*An average female is represented: the range of ages within which some of the events may occur is given by the figures placed directly below them.

Fig 2

of SMR stage 2 and during SMR stage 3, approximately 6 to 12 months prior to menarche. It is estimated that 15 to 25% of final adult height is gained during the growth spurt of puberty[25] . The

average increase in height is estimated at 8.24 in (20.5 cm), with

a range of 2-10 in (5-25 cm) seen in most females [25,26]. During the peak of the linear growth spurt, females gain roughly 3.5 in (8 - 9 cm) per year. The linear growth spurt lasts 24 to 26 months, ceasing by 16.5 years of age in most females. Some adolescent females experience small increments of growth past age 19 years, however. Linear growth may be delayed or slowed among females who severely restrict their caloric intake. Peak velocity of linear growth occurs later in puberty among males than among females, most often during SMR stage 4, at 14.4 years of age on average. The greatest rates of linear growth among males coincide with or closely follow testicular development and the growth of facial hair. Adolescent males experience increases in height of 4-12 in (10-30 cm) during puberty, with an average of 2.8 - 4.8 in (7 - 12 cm) attained each year[25,26]. Linear growth continues throughout adolescence, at an increasingly slower rate, ceasing between 18 and 21 years of age.

Approximately half of maximal adult bone mass is accumulated during adolescence. By 18 years of age, more than 90% of adult skeletal mass has been accrued. It should be noted that more than one-third of adult bone mass is thought to accrue during and immediately following puberty[27,28]. After adult height is achieved, the accumulation of significant amounts of additional bone mass is unlikely.

Psychosocial:

Adolescence is a period of psychological and emotional upheaval. Adolescents feel concerned about how they look, they like to spend more and more time with the friends of their age and of their own sex. At times there is confusion of thoughts. Sometimes, they become very sociable. They feel that their parents are not treating them like adults and hence the parents do not take their opinion into consideration. They take more interest in novels, films or music and dance.

Menarche (first menstruation) comes as a shock to the girls who are not informed about it. Many have a feeling of becoming ‘impure’ during the menstruation. Whatever has been gifted by nature needs to be

accepted with a sense of joy. Insecurity, fear, anger, frustration, peer pressure and drive for freedom may be the causes for the youngsters to get addicted to smoking, drugs and alcohol. This has become a global concern. We all collectively have to establish a good communication with them, supply them with the information they need, care for them, guide them and give them moral and emotional support; because they are our future.

Need to Monitor Growth:

The period of adolescence is a crucial phase of growth and offers the last chance of catchup growth. Achievement of optimum growth during this period is of utmost importance in maintaining good health thereafter[29]. However little is known about nutritional status both in developed and developing countries. One reason for this gap in knowledge is the lack of an internationally agreed method for assessing nutritional status during this period of life. Growth monitoring by anthropometric measurement during this period is not only an important health indicator but also a predictor of various morbidity in the community, it is still an underutilized tool for guiding public health policy as well as individual clinical decision[30].

Simple measurement of height and weight serve as reliable means to evaluate the growth of a child and also to detect gross abnormalities even when no other clinical sign of illness is manifested [4].

In a country like India with wide variation in the growth determinants, it is essential that the normal values are developed region-wise and are redefined from time to time[31, 32]. Most of the attempts of generating anthropometric profile have so far focused on pre-school children and a very few have dealt with adolescents age groups[33].

Growth Monitoring

Normal growth is a sign of good health and ill children often grow slowly, so growth needs to be monitored for important health problems. The value of growth monitoring in developing countries has

recently been questioned [34,35].In some conditions, the child is abnormally short or tall from infancy onwards, whereas in others initial normal growth is followed by growth failure or acceleration. Individual measurements at a single point in time detect absolute short or tall stature but two or more measurements over a period of time are needed to detect a change in growth rate irrespective of the starting height – hence the preferred term is " Growth monitoring", not "screening".

Growth monitoring is defined as a form of screening – it involves offering a simple rapid test to apparently healthy people, to separate a group of subjects who are at high risk of having abnormal growth from a larger group who are at lower risk[35].

Growth assessment is the single most useful tool for defining health and nutritional status in children at both the individual and population levels. This is because disturbances in health and nutrition, regardless of their etiology, almost always affect growth[5]. Proper growth monitoring consists of serial assessments of anthropometric indices. In some situations, a single set of measurements may be used for screening populations or individuals to identify abnormal nutritional status and priority for treatment. Growth monitoring strives to improve nutrition, reduce the risk of inadequate nutrition, educate caregivers, and produce early detection and referral for conditions manifested by growth disorders [36]. At the population health level, cross-sectional surveys of anthropometric data help define health and nutritional status for purposes of program planning, implementation, and evaluation. In all settings, growth monitoring is also used to assess the response to intervention [37].

Benefits of growth monitoring include identification of chronic disorders; to provide reassurances to parents; monitoring the health of the children; and supporting future research[35].

Anthropometry and Reference Standards:

Nutritional status of individuals and populations can be assessed by anthropometry and by biomedical methods. Anthropometry involves measurement of body dimensions, e.g. weight and height, and comparing them with reference standards. It is simple, safe, easy to perform, relatively

inexpensive, non-invasive, and portable, and requires minimal training. It can identify individuals and populations with normal and abnormal nutritional status and social and economic inequity. Anthropometry can predict who will benefit from specific interventions and also help evaluate the impact of interventions. The major variables used in anthropometry include sex, age, weight, length or height, BMI (Body mass index) and mid-upper arm circumference. When two variables are used together for comparison with a reference standard, they form an anthropometric index, i.e. weight-for-age, weight-for-height, or height (or length)-for-age. The effect of a sudden nutritional deficiency in any population is first detectable in under-5 children in that community[38].

Biomedical methods of assessment require measurement of body constituents, e.g.biochemical measurements (serum albumin) or assessment of body composition using techniques, such as bioelectric impedance analysis. These methods, yet expensive, are not readily available in situations where they are needed most.

Anthropometric indices:

Weight-for-age (WA) is a measure of the child's weight in relation to his age. It tells us how deviant the child's weight is from the reference standard weight of children of same age and sex. A child with low weight-for-age is underweight. Only the body weight has to be measured and the age of the child determined from records or by asking the mother. As age can be unreliable in many communities, weight-for-age may not always be correct.

Height-for-age (HA) is a measure of how tall or short the child is in relation to his age. A child with low height-for-age suffers from stunting. Since height does not increase in children as rapidly as weight does, an inadequacy in height-for-age is a reflection of long-term food shortages or chronic malnutrition. For children aged less than 2 years, shorter than 85 cm tall or too ill to stand, length is measured instead of height[38].

Weight-for-height (WH) is a measure of how thin or fat a child is compared to his height. It is affected by an acute shortage of food and is, therefore, a good indicator of short-term malnutrition both at the clinical level when dealing with the individual sick child and at the population level when faced with an emergency situation, like a famine. The advantage of weight-for-height is that it does not depend on the age of the child. This is of great advantage in populations where caregivers are unaware of the child's date of birth, hence an accurate age in months. However, a limitation is that both weight and height have to be measured which is difficult in field settings.

Body mass index (BMI) is an anthropometric index of weight and height, defined as body weight in kilograms divided by height in meters squared.

BMI = weight (kg)/height $(m)^2$

In adults, BMI has been the most widely investigated and accepted index for classifying adiposity, as well as the most useful indicator for identifying health risk associated with overweight. International recommendations for the use of BMI as a first indicator in assessing fatness in children and adolescents are relatively new [37,39]. Because adiposity varies with age and gender during childhood and adolescence, BMI is age and gender specific; consequently, BMI is plotted according to age, using sex-specific charts. BMI-for-age provides a reference of overweight for older children and adolescents that was previously not available. In addition, BMI-for-age is also a predictor of health risks and future risk of being overweight . It is strongly associated with clinical risk factors for the diseases associated with overweight. BMI is significantly correlated with direct measures of body fat, as well as subcutaneous measures. BMI is now recommended for screening overweight in children (over age two) and adolescents, rather than weight-for-stature[39]. BMI values at ages below two have not been associated with adolescent or adult obesity; use of BMI before 24 months of age is therefore not recommended.

Weight-for-stature and BMI-for-age are not interchangeable and do not produce equivalent results[37]. Weight- for-stature percentiles tend to be lower than BMI-for-age centiles.

American BMI Charts

In 1995 the WHO recommended 10 use of BMI values based on American data from 1971-1974 78; however, this data has been updated in the 2000 CDC BMI charts. (CDC Growth charts) The CDC utilizes the following cut-off points and terminology to classify abnormal body weights which could pose medical risks:

BMI for Age ≥ 95% Over weight.

BMI for Age ≥85% <95% Risk of overweight

BMI for Age < 5% underweight

"Overweight" and "At risk of overweight" are the terms chosen to refer to children and adolescents whose excess body weight could pose medical risks. The CDC has chosen to use the term "overweight" to avoid potential negative connotations associated with the term "obesity". At the 95th percentile, very few children will be incorrectly classified, although some children with excess adiposity will be missed (i.e. low sensitivity and high specificity). This approach avoids potential psychological and physical harm from misclassifying and treating children who are not obese. An additional cut-off point at the 85th percentile was set to lessen the chance of missing at risk children.

The CDC cut-off point for underweight is based on WHO recommendations10; however, scientific research and clinical experience are lacking regarding its use in underweight and the choice of the 5th percentile as the cut-off. While BMI-for-age < 5th percentile may be used, with an awareness of its limitations, the current practice of using body weight < 89% of ideal (i.e. ≤ 89% IBW) 80 or weight-for-length/ stature < 3rd percentile as surrogate measures of underweight in Canadian infants and children continues to be recommended

Comparison to Reference Standards

References are used to standardize a child's measurement by comparing the child's measurement with the median or average measure for children at the same age and sex. For example, if the length of a 3 month old boy is 57 cm, it would be difficult to know if that was reflective of a healthy 3 month old boy without comparison to a reference standard. The reference or median length for a population of 3-month-old boys is 61.1 cm and the simple comparison of lengths would conclude that the child was almost 4 cm shorter than could be expected. When describing the differences from the reference, a numeric value can be standardized to enable children of different ages and sexes to be compared. Using the example above, the boy is 4 cm shorter than the reference child but this does not take the age or the sex of the child into consideration. Comparing a 4-cm difference from the reference for a child 3 months old is not the same as a 4-cm difference from the reference for a 9 year old child, because of their relatively different body sizes.

Taking age and sex into consideration, differences in measurements can be expressed a number of ways:

a. Standard deviation units or Z-scores (WAZ, HAZ, WHZ)

b. Percentiles (WAP, HAP, WHP)

c. Percentage of median (WAM, HAM, WHM).

a. Z-scores

Z-score (or standard deviation score) is the deviation of the value for an individual from the median value of the reference population, divided by the standard deviation for the reference population.

Z score is calculated from the following formula:

SD score = Individual's value - median value of reference population
SD value of reference population

The distribution of Z-scores follows a normal (bell-shaped or Gaussian) distribution.

Z-score cut-off values of anthropometric indices in children

Anthropometric indicator	Cut-off value	Term
Weight-for-age z-score	-3.00 to 2.01	Moderate underweight
	<-3.00	Severe underweight
Weight-for-height z-score	-3.00 to 2.01	Moderate wasting
	<-3.00	Severe wasting
Height-for-age z-score	-3.00 to 2.01	Moderate stunting
	<-3.00	Severe stunting

Table 2

b. Percentiles

Percentile means the rank position of an individual on a given reference distribution, stated in terms of what percentage of the group the individual equals or exceeds. If a child's weight for- age falls on the 25th percentile, this means that 25% of the population in his age-group and sex have a weight lower than his height and 75% of that age- and sex-matched population have a weight which is higher. Percentiles are more commonly used in clinical work, because many growth charts are categorized by percentile cut-offs: 3rd, 10th, 25th, 50th, 75th, 90th, and 97th percentiles. Percentile growth charts are a quick screening tool for an individual child but are of no use in population-based nutrition surveys of young children.

c. Percentage of median

Percentage of median is the ratio of a measured value in the individual, for instance weight, to the median value of the reference data for the same age or height, expressed as a percentage.

This can be written in equation form as:

The median is the value at exactly the midpoint between the largest and smallest. If a

$$\text{Percent of median} = \frac{\text{observed value}}{\text{median value of reference population}} \times 100$$

child's measurement is exactly the same as the median of the reference population we say that they are "100% of the median." This is now hardly used when comparing large datasets or in international literature.

The following table summarizes the characteristics of the 3 methods of expressing and reporting anthropometric data.

Comparison of characteristics of z-score, percentile, and percentage of median in reporting anthropometric data

Characteristics	Z-score	Percentile	Percentage of median
Adherence to reference distribution	Yes	Yes	No
Linear scale permitting summary statistics	Yes	No	Yes
Uniform criteria across indices	Yes	Yes	No
Useful in detecting changes at extreme of the distribution	Yes	No	Yes

Table 3

the reference population and making comparisons to it. It is the statistic recommended for use when reporting results of nutritional assessments. For e.g. a child with severe wasting (WHZ 4.5), admitted for nutrition rehabilitation, can be followed up with serial WHZ to decide when he is ready for discharge[30].

Cutoffs

The use of a cut-off enables the different individual measurements to be converted into prevalence statistics. Cut-offs are also used for identifying those children suffering from or at a higher risk of adverse outcomes. The children screened under such circumstances may be identified as eligible for special care. The most commonly used cut-off with Z- scores is -2 standard deviations, irrespective of the indicator used. This means children with a Z-score for underweight, stunting or wasting, below -2

SD are considered moderately or severely malnourished. For example, a child with a Z-score for height-for-age of -2.56 is considered stunted, whereas a child with a Z-score of -1.78 is not classified as stunted[40].

In the reference population, by definition, 2.28% of the children would be below -2 SD and 0.13% would be below -3 SD (a cut-off reflective of a severe condition). In some cases, the cut-off for defining malnutrition used is -1 SD (e.g. in Latin America). In the reference or healthy population, 15.8% would be below a cut-off of -1 SD. The use of -1 SD is generally discouraged as a cut-off due to the large percentage of healthy children normally falling below this cut-off. For example, the 1995 DHS survey using a –2 SD cut-off for stunting in Uganda found a 36% prevalence of stunting in under-three year olds. This level of stunting is about 16 times the level of the reference population.

A comparison of cutoffs for percent of median and Z-scores illustrates the following:

90% = -1 Z-score

80% = -2 Z-score

70% = -3 Z-score (approx.)

60% = -4 Z-score (approx.)

Importance of accurate measurements

Effective growth monitoring needs precise measurements, accurate plotting on appropriate charts, correct interpretation, and a plan to investigate positive cases[41,42,43.] Accurate measurements have three components: a standardized measurement technique, quality equipment that is regularly calibrated and accurate, and trained measurers who are reliable and accurate [41,42,43]. Reliable growth data do not require expensive equipment, just careful technique, and accurate charting[44]. Using a consistent growth chart, appropriate for age and gender, a child's measurements should be recorded in the data table of the chart and then plotted to identify any disturbances in height or weight gain.

Measuring height is a subject to error as a result of poor technique, variations between instruments and observers, diurnal variation, and plotting mistakes[45,46,47.] A degree of imprecision is inevitable, because over 90% of the variation between height measurements is the result of the fact that children are not rigid objects and do not have an exact or correct height[46]. Nevertheless, with training and care single height measurements can be obtained with acceptable precision, especially over the age of 3 years[48].

Frequency of growth monitoring

The optimal frequency for monitoring height and weight in healthy children over age six has not been evaluated; however, it seems reasonable to continue annual monitoring of growth for the early identification and referral of a child whose abnormal stature or rate of weight gain may indicate a problem that might require treatment. In cases where a growth problem is suspected, or a child's response to therapy is being monitored, more frequent measurements may be indicated[37].

GROWTH CHARTS

Growth charts are defined as a graphic presentation of body measurements that aid in the assessment of body size and shape, and in the observation of trends in growth performance. They are used in the assessment and monitoring of individual children and in screening whole populations [49]. Growth charts are not diagnostic and should be used in conjunction with other information when evaluating a child's general health. There is an important distinction between a growth reference and a growth standard. A reference simply describes its sample without making any claims about the health of its sample, whereas a standard represents 'healthy' growth of a population and suggests a model or target to try and achieve[30,49.] Growth charts currently in use describe existing growth patterns and are therefore references, not prescriptive standards [49].

British charts

A few pediatric centres prefer British charts by Tanner and Whitehouse[51, 52] for their longitudinal data collection, truer velocity charts, depiction of standards for stages of pubertal development and allowance for variability in onset and duration of puberty, and a table simplifying precise calculation of age. These charts have been declared obsolete and have been replaced with the UK90 references, which were based on more recent, larger cross-sectional data[53]. The new British charts include weight, height, BMI, head circumference and stages of puberty, from birth to 20 years. These charts, which are now 13 years old, used data from seven different sources, not all of which were nationally representative.

American charts

NCHS charts, 1977

In 1977, the National Center for Health Statistics (NCHS), which is now part of the Centers for Disease Control and Prevention (CDC), developed growth reference charts that were based on representative samples of the population of the United States. The infant charts in 1977 were developed using longitudinal data from the Fels Research Institute, collected in Yellow Springs, Ohio, between 1929 and 1975[54,55].

WHO reference growth charts, 1983

In 1978, the CDC modified the 1977 growth reference charts to develop a set of growth curves approximating normal distributions that would allow calculation of standard deviation scores (z scores) for values above and below the median[5]. These modified charts have been subsequently used globally because of their adoption for international use by the World Health Organization (WHO) [57-59.]

The international version of the reference was published by WHO in 1979 and was revised 4 years later

to create the 1983 WHO reference growth charts. This international adoption was made because it was judged that these data from the United States were the best available at the time and because of our understanding that children who are living in good conditions grow very similarly.

Review of the growth charts

About 10 years ago, both NCHS/CDC and WHO independently but cooperatively began the processes of extensively reviewing the uses and interpretations of growth information. Included in these reviews was consideration of the limitations of the currently used reference growth charts. Although these reviews differed somewhat in process and outcome, both the reviews reached a consensus regarding the following 4 main Limitations of the current reference: (i) the sample of Caucasian, middle-class infants from Ohio used in the very initial years of life was not adequate to describe well the growth of infants in the United Sates, (ii) the frequency of measurements on young children was not sufficient to capture well early growth trends, (iii). there were inadequate numbers of infants who were breastfed, and (iv) technical problems with curve construction could be improved through the use of more modern statistical tools

As a result of the recommendations from these reviews, both NCHS/CDC and WHO set out to construct new reference growth charts.

Revised CDC reference growth charts for the United States

In May 2000, the NCHS/CDC released revised reference growth charts for the United States. These charts were created with improved data and statistical curve smoothing techniques. Data were taken from 5 national health examination surveys collected from 1963 to 1994 and 5 supplementary sources. These were combined into one analytic data set to produce the reference growth charts. These data better represent racial and ethnic diversity in the United States and contain a mixture of growth data from infants who were breast- and formula-fed. Included in the revised charts for the first time were

charts for body mass index.

The 2000 CDC charts offer numerous improvements to the 1977 NCHS charts[60], including:

- more recent national survey data (1963-94) plus supplemental infant data to better portray the racially and ethnically diverse population and more closely match current national birthweights
- addition of 3rd and 97th percentiles to provide more realistic cut-offs for referral than the previous 5th and 95th outer curves (a larger sample size and improved statistical methods made it possible to estimate these outer centiles more accurately)
- addition of BMI-for-age curves to evaluate weight as a function of height, a feature that had been missing for older children and adolescents
- improved representation of breastfed infants based on their national distribution over the past 30 years (50% breastfed; ~ 33% breastfed > or = 3 months); however, the curves continue to show somewhat different patterns of growth than typically observed in healthy breastfed infants, due to the relatively short duration of breastfeeding[60] .

- Correction of the previous disjunction that occurred between 24 and 36 months when switching from length to stature. A small disjunction still remains because stature is shorter than length measurement by approximately 0.8 cm.

WHO charts

In 2005 the WHO, in collaboration with the United Nations Children's Fund and others, has developed a new international growth reference representative of children (birth to age five) being raised according to recommended health practices [61,62,63].

These conditions include:

1. exclusive or predominant breastfeeding for four to six months, complementary foods by six months, continued breastfeeding for 12 months or more

2. an optimal environment without microcontammants or conditions that could limit growth (smoking, altitude >1500 m)
3. optimal health care (immunizations, good routine pediatric care). This desirable approach in extensively prescribing the nature of the sample population is another example of creating a reference to approximate a standard[62].

Indian studies:

There are lots of studies done in India right from 1941 but the landmark study was the ICMR study done in 1972 for children aged 0 to 21 years[7]. The study included 1,27,866 children from various states in India. The conclusions drawn were that boys were taller than girls at all ages except between 10 to 12 years and were heavier than girls too except between ages 9 to 15 years. They also showed that the Indian children were lighter and shorter than their counterparts in the United States and Britain. Children in the affluent socio-economic class however displayed similar growth patterns as British children.

In the Agarwal study was done in 1992 in affluent Indian children from 5 to 18 years of age. The study has shown that 50^{th} centile height of Indian boys was lying in between 30 – 40^{th} centile of NCHS height till 6.5 yr of age. In later years it continues to be in 20 – 30^{th} centile but the final stature falls in 10 – 20^{th} centile of NCHS. For girls 50^{th} centile is lying in 30 – 40^{th} of NCHS till the onset of puberty which later dips to 20^{th} –30^{th} centile and the ultimate height attained of indian girls is between 10^{th} and 20^{th} centile of NCHS. Thus the Indian affluent children in the present study are shorter by 8 cm for boys at 18 yr and 7 cm for girls at 17 yr as compared to recent European data [8].

Implications for the use of reference growth charts

The construction and release of new reference growth charts has 3 important implications for healthcare workers, childcare-givers, agency officials, and others who use growth information. First,

after about 20 years multiple reference growth charts are now available. The Revised CDC reference growth charts for the United States will likely to be widely adopted in the USA. However, the 1983 WHO reference growth charts continue to be preferred for international use. Second, the adoption of any new reference growth charts means that many decisions must be made on how to transit from the old to the new. For e.g., existing copies of the previous growth charts need to be replaced, growth information for some children may need to be transferred to the new charts, and computer software may need modifications. Guidance and training are required to help people who use growth information to make the transition to the new charts. Third, any new reference growth charts will likely portray the expected growth differently than did the previous charts that they are replacing. That is, the growth of the reference populations will be somewhat different[37].

Considerations in interpreting growth charts

There are several key points to remember when interpreting patterns of growth on a growth chart:

In general, the percentile positions of various anthropometries will be approximately the same in a normal child, with a gross difference in one indicating a potential problem.

The more deviant an individual's anthropometrie measure is, the more likely it is that a problem exists.

- Despite many parents' perceptions, the 50th percentile is not the goal for each child.
- The direction of serial measurements on the curve is more important than the actual percentile
- In most children, height and weight measurements follow consistently along a 'channel' (i.e. on or between the same centile(s)). Normal children often shift percentiles for both length and weight in the first two to three years of life with the majority settling into a channel towards the 50th percentile (i.e. regression toward the mean) rather than away.
- With the exception of the first two to three years of life when channel 'surfing' is normal and during puberty, when the age at onset is variable, crossing centiles or channels is a potential sign of a growth disturbance[64,65.] Serial measurements showing unexpected crossing of two or more centiles

downwards from a previously established rate of growth is considered to reflect failure-to-thrive (FTT) or growth failure[64].

- Breastfed infants grow differently from formula-fed infants during the first year of life. In particular, Breastfed infants tend to become leaner after three to four months of life. These differences should be anticipated when assessing growth of an exclusively Breastfed infant in order to avoid unnecessary investigations, supplementation with formula or early introduction of solids.

Health care providers are encouraged to take the time to teach children and their caregivers how to interpret the growth chart and the expected target growth pattern.

SEXUAL AWARENESS

Adolescents comprise 20 per cent of the global population. Out of 1.2 billion adolescent population worldwide 85% live in the developing countries according to IAP chapter[66]. Further more the adolescent population in developing countries is expanding, with the number of urban youth growing to a projected 600 per cent between 1970 and 2025. Twenty one per cent (210 million) of India's population is in the age group of 10-19 years[67]. Adolescent period, is a time of self-discovery as they go through physical, sexual, psychological, social and economic changes.

Sexual and psychosocial development

Sexual

"Sexuality" refers to the total sexual make up of an individual, covering the physical aspects, attitude, values, experience, and preferencesc[68]. Frequently, sexuality presents, the first challenge to

healthy growth and development during adolescence. Often unplanned and sometimes forced, adolescent sexual relations occur before young people acquire adequate knowledge about contraception, sexually transmitted disease or health services available to them[69]. During their development from boyhood to man adolescent males are often expected to prove their "masculinity" to their peers and elders. The behavioral expression of "masculinity" is not determined by biology; it is largely acquired through socialization leading to the internalization of a set pattern of "male" attitudes and values. Adolescent boys learn their societies interpretation of "masculinity" from their parents, peers, the mass media and by observing the behavior of adults. The developmental processes of the childhood and adolescent years, combined with the traditional requirements with masculinity define the sexual scripts for many young

males [69].

Psychosocial development

Psychological development occurs against a background of rapid physical change, including puberty, the pubertal growth spurt, and accompanying maturational changes in other organ systems. During adolescence teens develop a stronger recognition of their own personal identity, including recognition of a set of personal moral and ethical values, and greater perception of feelings of self-esteem or self worth. Psychosocial and cognitive development is best understood when divided into three periods: early adolescence (11-14 years), middle adolescence (15-17 years), and late adolescence (18-21 years). Each of these distinct periods of development is marked by the mastery of new emotional, cognitive and social skills (Table 4).

Table 4

Psychosocial Processes and the Substages of Adolescent Development

Substage	Emotionally Related	Cognitively Related	Socially Related
Early adolescence	Adjustment to a new body image, adaptation to emerging sexuality	Concrete thinking; early moral concepts	Strong peer effect
Middle adolescence	Establishment of emotional separation from parents	Emergence of abstract thinking, expansion of verbal abilities and conventional morality; adjustment to increased school demands	Increased health risk behavior; sexual interests in peers; early vocational plans
Late adolescence	Establishment of a personal sense of identity; further separation from parents	Development of abstract, complex thinking; emergence of post-conventional morality	Increased impulse control; emerging social autonomy; establishment of vocational capability

Source: Reprinted from Ingersoll GM, Psychological and social development. In: McAnarney E. Textbook of adolescent medicine © 1992, with permission from Elsevier.

Adolescents experience dramatic biological changes related to puberty; these biological changes can significantly affect psychosocial development. An increased awareness of sexuality and a heightened preoccupation with body image are fundamental psychosocial tasks during adolescence. Dramatic changes in body shape and size can cause a great deal of ambivalence among adolescents, especially among females, leading to the development of poor body image and eating disturbances or disorders if not addressed by family or health care professionals. Similarly, a perceived delay in sexual maturation and biological development, especially among males, may lead to the development of poor body image and lowered self-esteem. It is imperative that health professionals who work with adolescents have a clear understanding of how normal psychosocial and cognitive development relate to biological growth and development, and are able to appreciate how these processes affect nutritional intake and status[70].

Peer influence is a dominant psychosocial issue during adolescence, especially during the early stages. Young teens are highly cognizant of their physical appearance and social behaviors, seeking acceptance within a peer group.

The broad chronological age range during which biological growth and development begins and

advances can become a significant source of personal dissatisfaction for many adolescents as they struggle to conform to their peers. Males who enter puberty at a later age may consider themselves to be late bloomers, and may feel physically inferior to their peers who mature earlier. This sense of dissatisfaction may lead to the use of anabolic steroids and other supplements in an effort to increase linear growth and muscle development and to gain weight. Such dissatisfaction can also lead to markedly reduced self-esteem. For females, however, it is often early maturation that is associated with poor body image, poor self-esteem, frequent dieting, and, possibly, disturbed or disordered eating behaviors. Early maturing female teens are also at increased risk for engaging in other unhealthy behaviors such as smoking, alcohol consumption, and early sexual intercourse[71-73]. Young adolescents should be educated on normal variations in initiation and progression of biological growth and development in an effort to facilitate the development of a positive self-image and body image and to reduce the likelihood of early initiation of health compromising behaviors.

The early stage of adolescence is a time of great cognitive development. At the beginning of adolescence, cognitive abilities are dominated by concrete thinking, egocentrism, and impulsive behavior. The ability to engage in abstract reasoning is not highly developed in most young teens, limiting their capacity to comprehend nutrition and health relationships. Young adolescents also lack the skills necessary to problem solve in an effort to overcome barriers to behavior change and the ability to appreciate how current behaviors can affect future health status.

Middle adolescence is characterized by growth in emotional autonomy and increasing detachment from family. This is a period of emotional upheaval. The bulk of physical growth and development is completed during this stage, however body image concerns may continue to be a source of trepidation, especially among males who are late to mature and females who have experienced great changes in body composition and size.

These changes unsettle a number of adolescents leading an adolescent becoming unduly self conscious or somewhat imbalanced in responses which occasionally can last throughout life[74]. Adolescence is also the period of experimentation, which exposes the youth to health risks through drugs, alcohol, tobacco use, irresponsible sexual behavior etc [75].

Several studies conducted on Indian adolescent have found that many adolescents particularly males are sexually active and are likely to indulge in unsafe sexual activities making them vulnerable to STD's including HIV infection. A survey shows that 50% of daily clientele of a STD clinic comes from 15 to 25 year age group. According to estimate by UNAIDS, by the end of 1999, there were already 33.6 million people worldwide with HIV infection altogether more than four million children under the age of 15 years and more than 10 million young people (15-24 years) have been infected with HIV since the epidemic began[75].

Sexual Awareness and Sex Education

Sexual Awareness comes through gathering information or self-education. Talking about these issues remains a taboo in a culturally and religiously diverse society like India. Sex education to be initiated in school syllabus will take years. Adolescents gather information about sexuality from friends and through the print and media. Often this information is incorrect and unscientific. This leads to an unnecessary fixation on sex related issues. Parents too do not discuss the problems related to sexuality, like the process of reproduction, doubts related to sexuality, and this leads to lack of healthy attitudes towards sex. They are driven by over curiosity and concern about sexuality of their own and of the opposite sex. They often don't have access to gather accurate information on the issues related to sexuality and sexual health, nor solutions for their problems, due to socio-economic barriers[13].

Lack of proper education and ignorance lead to sexual misconceptions, follows superstitious beliefs, lack of knowledge about safe sex methods and in turn will lead to unwanted pregnancies,

abortions, spread of STD, HIV. It is such a behavior that spreads HIV infection. Due to the widening age gap between menarche and marriage, there is a growing incidence of premarital sexual activity among adolescents. Although premarital sex is less common in Asia, it is clearly on the rise. The continuing prevalence of adolescent premarital sexual activity and the low contraceptive usage will result in adolescent pregnancy and childbearing. This will in turn have significant effect on maternal and child health[13].

The studies on the effects of sex education in schools show that sex and AIDS education often encourages young people to delay sexual activity and to practice safer sex, once they are active. This is contrary to the popular belief that teaching young people about sexuality and contraception encourages sexual experimentation. However this is not accepted by many. In a study of AIDS prevention program done by UNICEF of selected Municipal schools in Bombay, it was found that student queries ranged from sexual intercourse to marriage and sexual harassment. Many women's organizations feel that the girls should not be ignored about basic facts of life and become victims of sexual abuse, unwanted pregnancy and deception.

In the 1994 International Conference on Population and Development (ICPD) program that stresses the need to "protect and promote the right of adolescents to the enjoyment of the highest attainable standard of health, provide appropriate, specific, user-friendly and accessible services to address effectively their reproductive and sexual health needs, including reproductive health education, information, counseling and health promotion strategies"[76]. Knowledge alone has not been shown to effect adolescent behavior change. Teens who have been exposed to knowledge-based sex education programs have a significant increase in knowledge on testing but have not delayed coitus nor been more likely to use contraceptives [77]. Programs that tend to be successful in changing behavior are skill building, problem-solving and communication-based [78].

Understanding how adolescents make decisions in early sexual activities is critical for intervention efforts aimed at fostering positive youth development and decreasing the negative outcomes of adolescent sexual behavior.

Sex Education:

Aims of Sex education:

1. To help children understand that each part of the body and each phase of growth is good and purposeful.
2. To understand the process of reproduction.
3. To prepare children for the changes of developments which come with growing up.
4. To help growing people see that sexual conduct involving other persons needs to be based upon a sincere regard for welfare of the other.
5. Responsible sexual behavior.
6. Building up healthy attitudes to sex.

The aim is to prepare adolescents of today to be responsible and productive and have a positive socio-sexual behavior and to be caring and healthy adults of tomorrow. The need for this is knowledge, attitudes, and skill gained through sequential sexuality education programme.

Sex education is therefore essential. It includes

1. **Information:** To provide accurate information about sexuality, including growth and Development, human reproduction, anatomy and physiology of genital Organs, pregnancy, childbirth, parenthood, contraception, STD etc.
2. **2. Attitude, values, and insight:** Opportunity to question, explore and assess their sexual attitudes in order to develop their own values, increase self-esteem, develop insights concerning relationships with members of both genders etc.

3. **Relationships and interpersonal skills:** Help them develop skills like communication, decision making, assertiveness, peer refusal skills, and ability to create satisfactory relationships. Develop mutually pleasurable relationships.

4. **Responsibility:** To help young people exercise responsibility regarding sexual relationships, including abstinence etc.

There is little value in giving anyone information after the moment when they need it. Girls need to know about menstruation before it happens to them, and boys need to know about masturbation before they experience the desire to masturbate. Boys experience nocturnal emissions from the age of about 14 years and girls attain menarche at the age of about 13 years. Some boys and girls experience these events even a year or two earlier. It is felt that the adolescent sex education should begin before these events take place [13].

AWARENESS TOWARDS MENARCHE

The phenomenon of menstruation is peculiar to humans and apes. Other animals do not menstruate, though they have estrous periods. More than medical concern, menstruation has social, economic, psychological, and religious implications[78]. Though menstruation is a natural and normal physiological process for all healthy adult women, many myths, superstitious beliefs, and misconceptions still exist about it.

Women's perceptions of menstruation vary from culture to culture, country to country, religion to religion, and modified by age, literacy level, and professional status in the society. Women are even made to believe that menstruation is as natural as passing urine. Some even believe that menstruation is necessary to eliminate bodily toxins, and that if they do not menstruate they will become obese from toxins that will collect in their bodies[79].

Rakesh (1988) as cited by Mandal in 1994, reported that parent, especially the mothers do not educate their daughters about various aspects of menstruation such as age of its onset, its duration and healthy practices during menstruation. The girls are not motivated to take the event lightly. So, the inadequate knowledge, misconception, and wrong ideas lead to undue fear, anxiety, and undesirable attitudes in the minds of adolescent girls. The studies recommend a planned educational program to enlighten young adolescent girls for healthy practices on attaining menarche[80].

James (1997), in a study on menstrual hygiene, reported that adolescent schoolgirls of menstrual hygiene were inadequate. Today, women experience more episodes of menstruation than women do in the past. Cutinho and Segal states that woman now experience 400 episodes of menstruation in their lifetime, against only 150 in the last century[81]. This is due to fewer pregnancies, shorter breast feeding duration, early menarche, and late menopause[80].

Need for the study:

Thus the present study was undertaken to identify the learning needs of pre-adolescent girls with a view to develop and evaluate a planned teaching program on menstrual hygiene. It will help them to improve their self- care ability and follow healthy and hygienic menstrual practices.

AIMS AND OBJECTIVES

1. To construct growth chart for weight and height for adolescent school going children aged 12-17years of Vellore town.
2. To compare the Vellore town growth chart with CDC and Indian population reference chart.
3. To assess the knowledge of adolescent girls about menarche and menstruation.
4. To study the attitude and awareness, of puberty and sexual health in adolescent school going boys and girls.

MATERIALS AND METHODS

Study Design:

This is a cross-sectional study performed in the period between June and July 2006.

Sample Design:

The study was conducted in both English and Tamil medium schools in Vellore town. The list comprising of 26 schools in Vellore town was obtained from the District education officer. These schools were stratified based on location of school into urban and rural, and based on medium of education into Tamil and English. Seven schools were randomly selected from the list. Of these seven schools, three were rural (one was Tamil, one was English and one was both Tamil and English medium schools) and 4 were urban (one was Tamil, one was English, two were both Tamil and English medium schools). Consent was obtained from the principal of the concerned school. The study team comprised of investigator and a house surgeon from Department of Child Health collected the data. Age of children was determined from the register of the school. It was decided to study approximately 200 boys and 200 girls in each class. Only those children who were listed in the register to be in the age group of 12 to 17 years were included. The children were divided on the basis of age from 12 to 17 years with class intervals of 6 months. For convenience we used systematic sampling rather than random sampling for the selection of both boys and girls. Children whose birth dates were not known were excluded.

For the menstrual and sexual awareness study adolescent boys and girls of year XI and XII were randomly selected from four of the above schools.

Data Collection:

After confirming the age of the child, height and weight were measured by the investigator and

recorded by the house surgeon. Parent's education was also recorded.

Weight:

Weight was measured in Kilogram using a Electronic weighing scale (Essae). This is floor weighting scale with capacity range from 2 to 150 kg (with accuracy close to 100g). The portable scale, weighing 4 kg, includes a solar cell on-switch (light sensitivity 15 lux) and is powered by long-life lithium battery good for one million weighing cycles. The investigators weight was measured everyday in the morning for the sake of calibrating the machine. Each subject was made to stand erect with head held straight and child was weighed wearing minimum of clothing, without socks, shoes, or slippers.

Height

Heights were using a stadiometer, which as a measuring range upto 200cm. The measuring device was correctly installed and accurately calibrated and fixed to a wall, which was smooth and perpendicular to the ground. The child was made to stand on a flat surface with heels together, legs straight, and shoulders relaxed with heels, buttocks, and scapulae touching the wall. The child was instructed to look straight so that the line drawn from the tragus to the inferior orbital margin lay in a plane parallel to the floor (Frankfurt plane). The child was asked to take a deep breath and make himself as tall as possible without raising the heels. The right angle device of stadiometer was brought down and was held against the top of the head and the readings were taken to the nearest mm.

Statistical analysis of anthropometry data:

Data was entered into SPSS (version 12) program. The mean and standard deviation were calculated separately for both sexes using SPSS software. For each completed age group, heights, weights, and BMI were arranged in ascending order and exact centiles were estimated with respect to gender, using STATA 8.0 software. Cubic spline regression [82,83] technique (using STATA 8.0 software) was used to smoothen the relationship between height and weight with respect to completed age. Multiple linear

regression analysis was used to study the effect of age, sex and parental education simultaneously on height and weight of adolescent children.

Spline Regression is a more powerful method to analyze dose – response and trend analysis in epidemiological studies. It is used to split the exposure into several classes and modeling the relationship between the exposure and the response by different function inside each class of exposures and having a continuous function. There are several methods in Spline regression such as linear Spline, quadratic Spline, and cubic Spline. Cubic Smoothing Spline is an alternative method to provide smooth relationship between the exposure and the outcome with minimum bias or variance. Using the cubic spline technique smoothed (predicted) centiles values were calculated.

The Cubic Smoothing Spline Model is

$$\sum_{i=1}^{n}\{f(x_i) - y_i\}^2 + \lambda \int_0^1 (Lf(x))^2 dx$$

where λ is fixed constant. The first term measures closeness to the data while the second term penalizes curvature in the function. In cubic smoothing spline, the overall adequacy of the model was assessed based on deviance in comparison with other models mentioned above.

The centile values of our adolescent boys and girls were also compared with the CDC centile values.

Statistical Analysis for sexual and menstrual awareness:

Data was entered in SPSS (version 12) software program. The data, after being entered and coded, was systematically tabulated and percentages were calculated. The answers were scored. The correct answers were given a positive score of +1 and other replies were given 0 and –1. The questions were divided into knowledge and attitude and their scores were entered as knowledge and attitude scores. The total scoring was done for both positive and negative scores. Attitude and knowledge scoring was done for only positive scores. These continuos variables were tested for significance using Independent

T test. The categorical variables like difference in sexual awareness with regard to knowledge and attitude between gender and medium of education were tested for significance using chi square test. Similar analysis was done for menstrual awareness questions as well.

RESULTS

Age Distribution of Boys and Girls:

Age in years	Sex		Total
	Boys (%)	Girls(%)	
12	72 (45)	88 (55)	160
12.5	95 (49.7)	96 (50.3)	191
13	92 (46.9)	104(53.1)	196
13.5	95 (44.4)	119 (55.6)	214
14	119(47.4)	132 (52.6)	251
14.5	102 (56.7)	78 (43.3)	180
15	75 (53.2)	66 (46.8)	141
15.5	67 (44.4)	84 (55.6)	151
16	81 (45.3)	98 (54.7)	179
16.5	63 (43.2)	83 (56.8)	146
17	99 (52.4)	90 (47.6)	189
Total	960 (48)	1038 (52)	1998

Table 5: Age distribution of boys and girls.

A total of 1998 children were included in the study. There were 960 boys (48%) and 1038 girls (52%). There was a minimum of at least 65 children in each age group.

Mean and Standard deviation of Heights of Boys and Girls:

Age In years	Boys			Girls		
	n	Mean	S.D	n	Mean	S.D
12	72	146.63	9.22	88	147.77	7.49
12.5	95	146.17	9.59	96	150.14	7.57
13	92	146.51	7.70	104	150.41	6.51
13.5	95	152.44	9.50	119	153.03	6.76
14	119	155.00	9.74	132	153.46	5.85
14.5	102	160.91	9.30	78	153.91	6.43

15	75	161.23	9.54	66	154.62	5.64
15.5	67	165.06	10.09	84	156.42	6.14
16	81	165.83	9.13	98	156.78	6.10
16.5	63	163.19	12.22	83	156.78	6.51
17	99	162.05	8.77	90	155.16	6.71

Table 6: Mean and standard deviation of height of Boys and girls.

Table 6 shows that girls are taller initially till 13.5 years of age, however from 14 years the boy's are taller than girls.

Mean and Standard deviation of Weights of boys and Girls:

Age In years	**Boys**			**Girls**		
	n	**Mean**	**S.D**	**n**	**Mean**	**S.D**
12	72	36.28	9.97	88	37.50	8.55
12.5	95	35.92	11.07	96	40.10	10.52
13	92	34.99	8.16	104	41.91	10.57
13.5	95	38.92	10.65	119	43.47	8.81
14	119	41.16	9.56	132	44.06	9.46
14.5	102	46.07	11.82	78	45.90	9.60
15	75	45.26	9.80	66	45.83	8.34
15.5	67	49.50	10.21	84	47.61	9.27
16	81	49.53	10.25	98	48.77	9.65
16.5	63	52.23	12.12	83	48.56	8.84
17	99	49.96	9.57	90	46.13	7.80

Table 7: Mean and standard deviation of weight of Boys and girls.

The girls are slightly heavier than boys till 15 years, however the boys are heavier than girls from 15.5 to 17 year.

Mean and Standard deviation of BMI of boys and Girls:

Age	**Boys**			**Girls**		
	n	**Mean**	**S.D**	**n**	**Mean**	**S.D**
12	72	16.66	3.15	88	17.02	2.94
12.5	95	16.57	3.69	96	17.61	3.58
13	92	16.19	3.05	104	18.39	3.92

13.5	95	16.53	3.24	119	18.52	3.40
14	119	17.00	3.05	132	18.62	3.41
14.5	102	17.60	3.28	78	19.34	3.55
15	75	17.24	2.42	66	19.14	3.12
15.5	67	18.07	3.10	84	19.43	3.51
16	81	17.90	2.80	98	19.83	3.64
16.5	63	19.57	3.58	83	19.76	3.48
17	99	19.08	3.74	90	19.15	2.95

Table 8: Mean and standard deviation of BMI of Boys and girls.

Table 8 shows girls had a higher mean BMI as compared to boys till 16 years of age after which BMI of boys are comparable with girls.

Parents Education:

Education	**Father**	**Mother**
	No of children (%)	**No of children (%)**
illiterate	137 (6.9)	264 (13.2)
1 - 5	122 (6.1)	193 (9.7)
6 – 8	233 (11.7)	368 (18.4)
9 – 12	1055 (52.8)	875 (43.8)
Graduates	345 (17.3)	182 (9.1)
DK	106 (5.3)	116 (5.8)
Total	1998 (100)	1998 (100)

Table 9: Distribution of children by parent's education.

Parents' education status varied from illiterate to graduation. 7 % of fathers and 13 % of mothers had not attended school. About 5% children were not aware of parents' education. 53% of fathers and 44 % of mothers had completed secondary school education. However, only 17 % fathers and 9% mothers had attended college.

Regression Analysis of age, sex and parental education on height and weight:

Variables	Height		Weight	
	Regression coefficient	p value	Regression coefficient	p value
Age	2.891	.000	2.796	.000
Sex	-3.088	.000	1.066	.015
Mother education	0.679	.000	1.081	.000
Father education	0.672	.001	.701	.002

Table 10:Multiple linear regression analysis

Height was positively related to age (2.89 cm increase in height for each 6 month increase in age, p value - < .001), sex (girls on an average were 3 cm less than the boys, p value - < .001), mothers education (p value < .001) and fathers education (p value <.001). There was a linear correlation of parent's education with height.

Weight was positively related to age (2.8 kg increase in weight for each 6 month increase in age, p value - < .001), sex (girls on an average one kg heavier than boys, p value = .015) mother education (p value < .001) and fathers education (p value = .002). There was a linear correlation of parent's education with weight.

Table 11: Observed Height for age for Boys aged 12 to 17 yrs.

Age (yr.)	Boys	Boy height (Actual Height)								
		P3	P5	P10	P25	P50	P75	P90	P95	P97
12	72	133	133	137	141	145	151.9	161	166.5	167.5
12.5	95	129	131.1	135.2	140	145	153	159.7	163	166.6
13	92	134	136	138	140	145.8	151.6	156.5	161	165
13.5	95	138	138	140.5	145	151	159	165.5	170	171
14	119	132	139	144	148	155	161	168	170.5	173.5
14.5	102	142	142	148.8	155.2	161.5	168	176.5	178.5	178.5

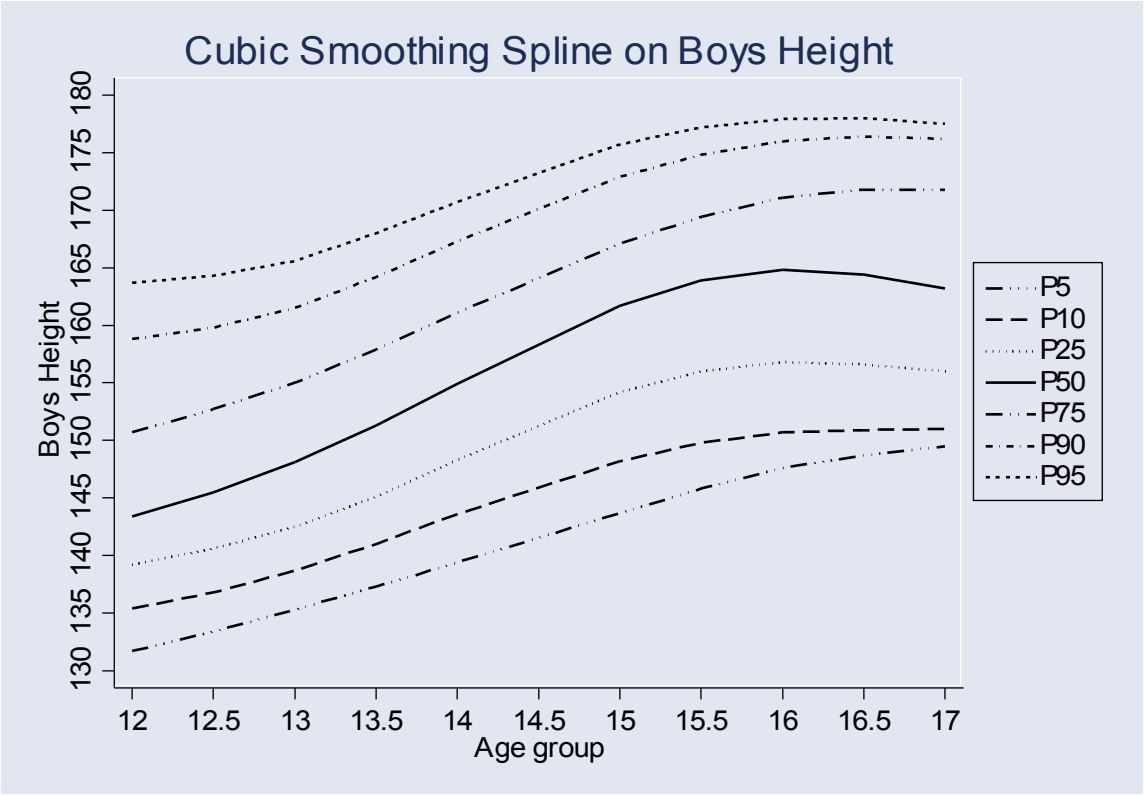
15	75	141.5	147	151	158	167.5	171	173	177	179
15.5	67	144	145.2	148	155	162	166.5	174	177	177.5
16	81	146.5	151	154.5	159	167.5	173	176.5	177	178
16.5	63	147	147	148	155	164	174	178.2	180	186
17	99	146	149	151	155	161	169	174	175.5	178.5

P= percentile

Table 12: Smoothed Percentile Height for age for boys aged 12 to 17 yrs.

Age (yr.)	**Boys**	**Boy height (Smoothed percentile)***								
		P3	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**	**P97**
12	72	131.2	131.7	135.4	139.2	143.4	150.7	158.8	163.7	165.9
12.5	95	132.1	133.4	136.8	140.6	145.5	152.7	159.8	164.3	166.9
13	92	133.3	135.3	138.7	142.5	148.1	155	161.5	165.6	168.2
13.5	95	134.7	137.3	141	145.1	151.3	157.9	164.2	168	170.3
14	119	136.3	139.4	143.6	148.3	154.9	161.1	167.3	170.7	172.7
14.5	102	140.8	143.7	148.2	154.2	161.7	167.1	172.9	175.7	177
15	75	143	145.8	149.8	156	163.9	169.4	174.8	177.2	178.7
15.5	67	143	145.8	149.8	156	163.9	169.4	174.8	177.2	178.7
16	81	144.9	147.6	150.7	156.8	164.8	171.1	176	177.9	180.1
16.5	63	146.3	148.7	150.9	156.6	164.4	171.8	176.4	178	181.1
17	99	147.3	149.5	151	156	163.2	171.8	176.2	177.5	181.4

*** Smoothed using Cubic Spline technique.**



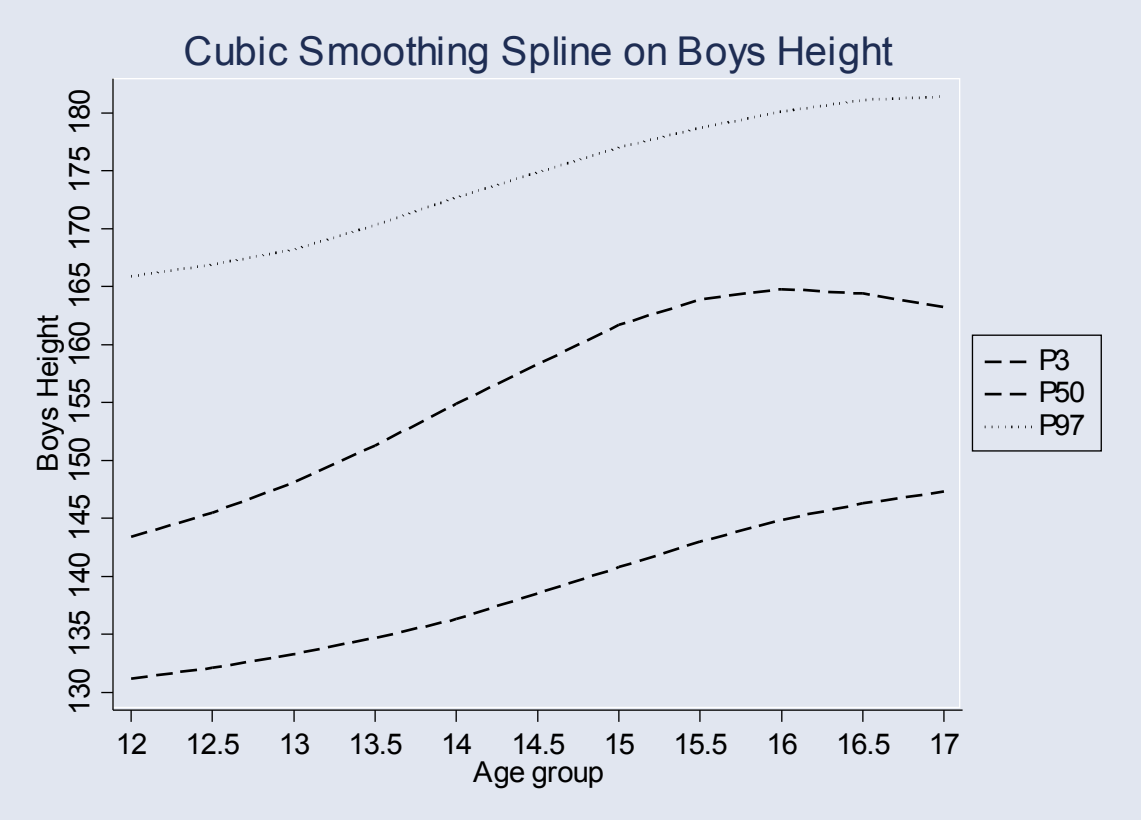


Fig 3 and 4: 3rd, 5th, 10th, 25th, 50th, 75th, 90th, 95th, 97th smooth centile curves: Height for age for boys from 12 to 17 years.

Table 13: Observed height for age for Girls aged 12 to 17 yrs.

Age (yr.)	**Girls**	**Girls height (Actual Height)**								
		P3	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**	**P97**
12	88	134	136.5	137.5	142	148.2	153.2	157	160	161
12.5	96	136	136	140.5	145.5	149.7	155.5	161	163.5	164
13	104	139	139.5	141.5	145.5	150	156	158.5	161	162
13.5	119	141	141.5	145	149	152	157	163.5	165	167
14	132	144	145	147	149.2	153.5	157.5	161.5	162.5	164
14.5	78	143	144	148	150.5	154.8	158.5	162.5	164	165

15	66	144	147	148.5	153	156	160.7	165	166	168
15.5	84	139	144.5	146.5	150.2	153.9	158	162	163	163
16	98	143	147.5	149	152	156.7	161.5	164.5	166.5	168
16.5	83	145	146.9	148.4	154	156.5	161	164	167	172
17	90	142.6	146	147.7	150	155	159	164	168.5	171

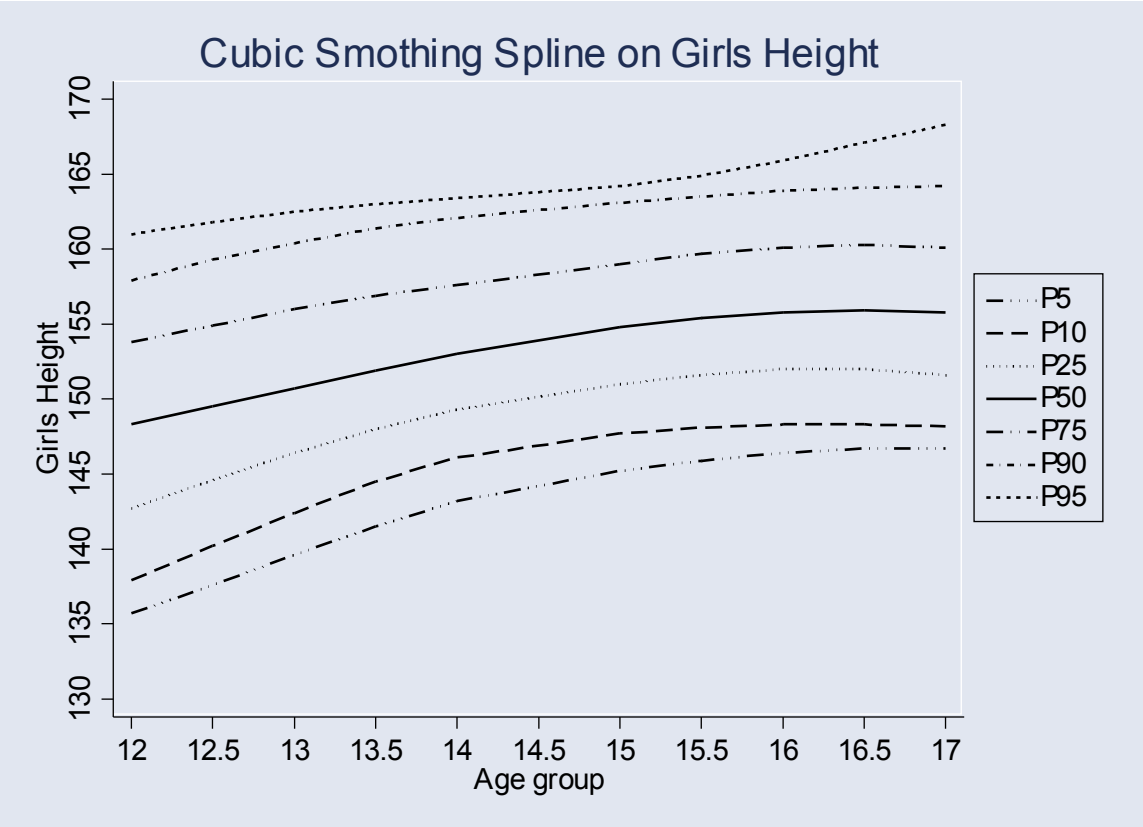
P= percentile

Table 14: Smoothed height for age for girls aged 12 to 17 yrs. (corrected)

Age (yr.)	**Girls**	**Girls height (Smoothed percentile)***								
		P3	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**	**P97**
12	88	134.3	135.7	137.9	142.7	148.3	153.8	157.9	161	161.8
12.5	96	136.7	137.6	140.2	144.6	149.5	154.9	159.3	161.8	162.8
13	104	138.9	139.6	142.4	146.4	150.7	156	160.4	162.5	163.5
13.5	119	140.8	141.5	144.5	148	151.9	156.9	161.4	163	164.1
14	132	142.1	143.2	146.1	149.3	153	157.6	162.1	163.4	164.4
14.5	78	142.7	145.2	147.7	151	154.8	159	163.1	164.2	165.2
15	66	142.7	145.9	148.1	151.6	155.4	159.7	163.5	164.9	166.3
15.5	84	142.7	145.9	148.1	151.6	155.4	159.7	163.5	164.9	166.3
16	98	143	146.4	148.3	152	155.8	160.1	163.9	165.9	168
16.5	83	143.3	146.7	148.3	152	155.9	160.3	164.1	167.1	169.9

17	90	143.4	146.7	148.2	151.6	155.8	160.1	164.2	168.3	171.7

*** Smoothed using Cubic Spline technique.**



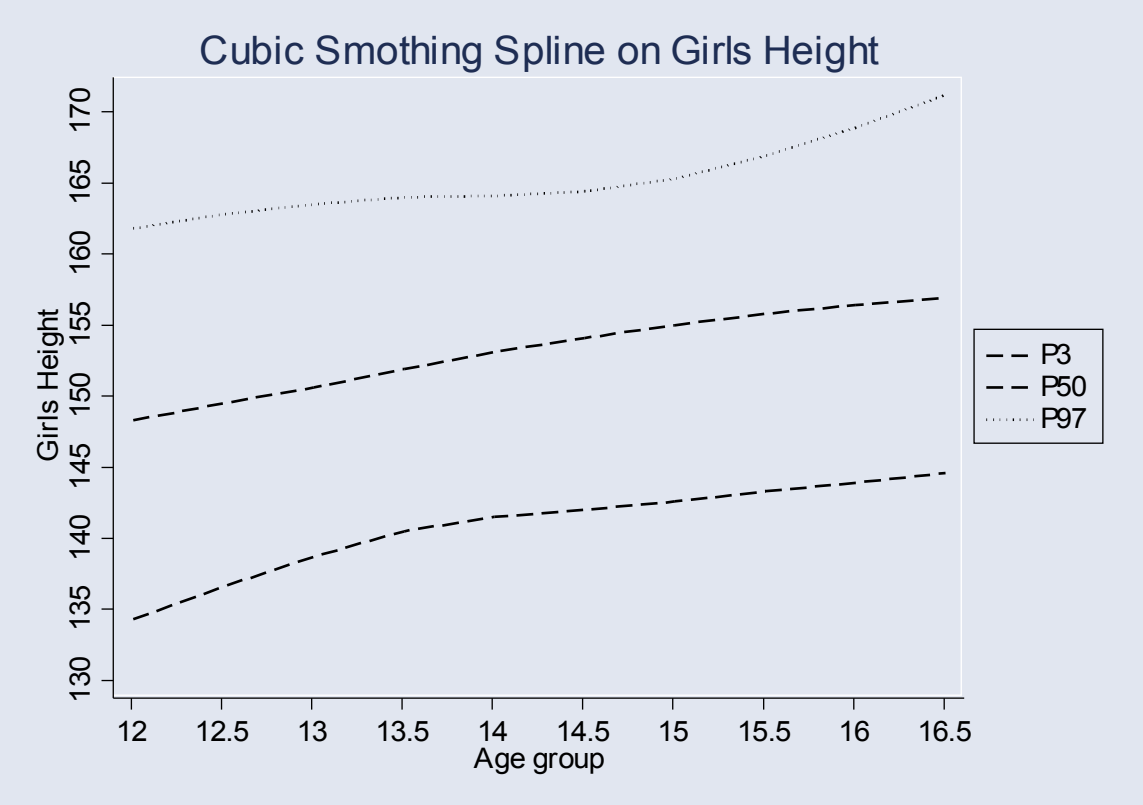


Fig 5 and 6: 3rd, 5th, 10th, 25th, 50th, 75th, 90th, 95th, 97th smooth centile curves: Height for age for Girls from 12 to 17 years.

Table 15: Observed Weight for age for boys (in Kgs)

Age (yr.)	Boys	Boy weight(actual weight)								
		P3	P5	P10	P25	P50	P75	P90	P95	P97
12	72	24.3	24.5	27.2	28.95	33.3	41.6	51.3	56.2	57.7
12.5	95	22.9	24	26.9	29.1	33	38.9	52.4	58.6	66.5
13	92	25.1	25.9	27.2	28.85	33.5	38.6	43.5	52.9	63.1
13.5	95	25.4	27.3	27.9	30.9	36.7	45.9	53	57.8	66.5
14	119	26.7	26.9	30	33.8	39.8	46.9	54.7	57	57.5
14.5	102	30.5	31.5	33.7	37.8	44.75	50	59.5	66	73.3
15	75	29.1	30.4	33.2	38.7	45.1	49.2	57	66.6	67
15.5	67	27.8	32.3	35.7	43.6	49.7	55.1	60.7	64.7	69.3
16	81	34.4	35.3	38.2	42	48.9	54.3	60.1	68.4	70.5

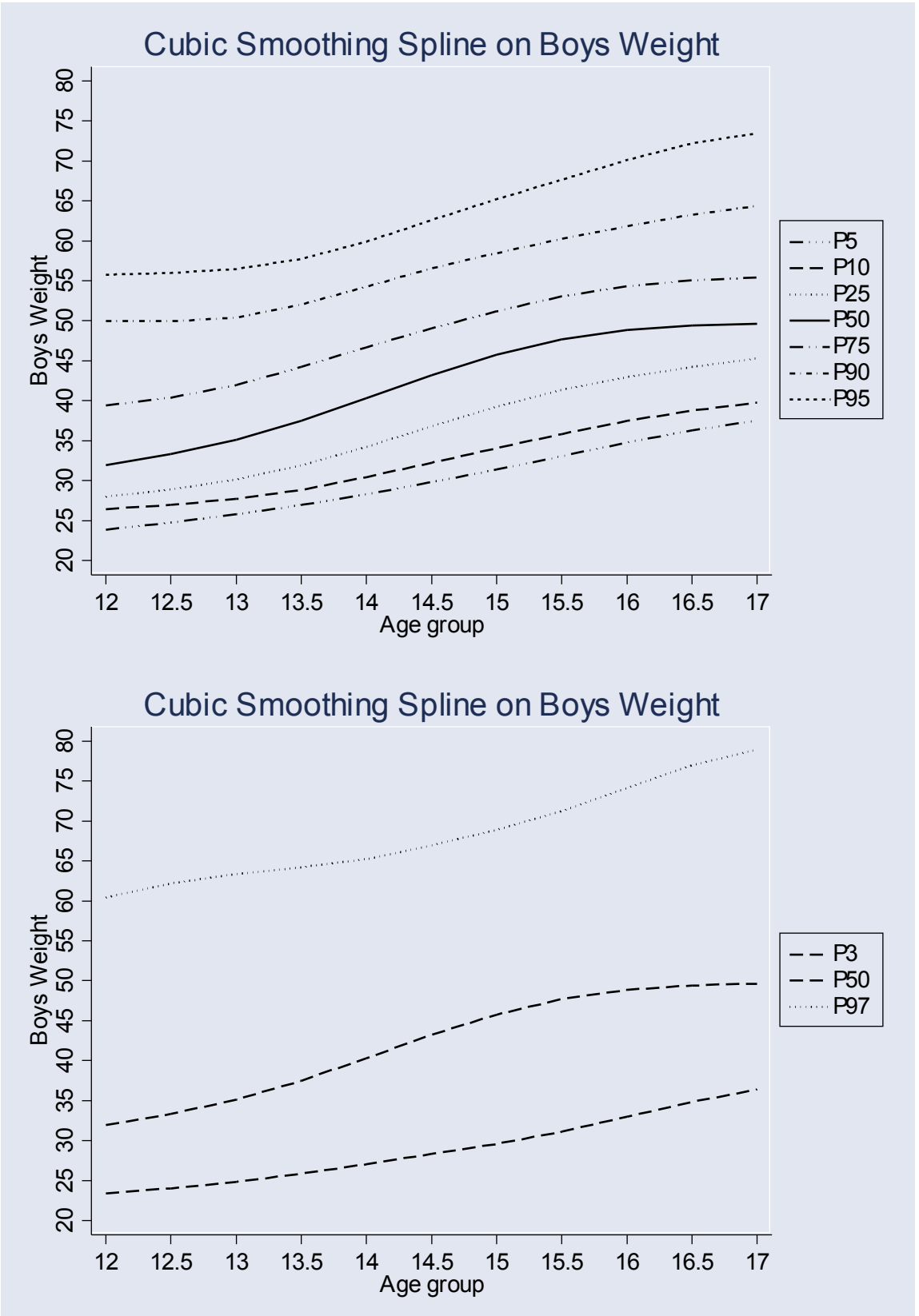
16.5	63	37.2	38.1	40	44.8	49.6	56.3	66.5	79.6	87
17	99	35	36.2	38.5	44.5	48.5	53.8	62.6	69.3	74.2

P=percentile

Table 16: Smoothed weight for age for Boys aged 12 to 17 yrs:

Age (yr.)	**Boys**	**Boy weight(Smoothed weight)***								
		P3	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**	**P97**
12	72	23.41	23.87	26.43	27.97	31.95	39.4	49.96	55.77	60.42
12.5	95	24.02	24.75	26.96	28.9	33.35	40.39	49.93	55.99	62.19
13	92	24.83	25.77	27.71	30.13	35.12	41.94	50.4	56.46	63.37
13.5	95	25.85	26.94	28.85	31.9	37.49	44.2	52.01	57.75	64.22
14	119	27.05	28.28	30.42	34.22	40.32	46.68	54.27	59.89	65.24
14.5	102	28.33	29.81	32.24	36.79	43.23	49.05	56.55	62.6	66.96
15	75	29.58	31.37	34.06	39.25	45.77	51.19	58.48	65.21	68.89
15.5	67	31.09	33.05	35.84	41.36	47.7	53.05	60.23	67.65	71.25
16	81	33	34.77	37.47	42.96	48.86	54.33	61.84	70.1	74.13
16.5	63	34.84	36.28	38.76	44.22	49.42	55.06	63.28	72.21	76.98
17	99	36.4	37.51	39.75	45.29	49.65	55.39	64.36	73.47	78.95

*** Smoothed using Cubic Spline technique.**


Cubic Smoothing Spline on Boys Weight
Boys Weight
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16.5
17
Age group
P5
P10
P25
P50
P75
P90
P95
Cubic Smoothing Spline on Boys Weight
Boys Weight
20
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15
15.5
16
16.5
17
Age group
P3
P50
P97

Fig 7 and 8: 3rd, 5th, 10th, 25th, 50th, 75th, 90th, 95th, 97th smooth centile curves: Weight for age for Boys from 12 to 17 years.

Table 17: Observed Weight for age for Girls aged 12 to 17 yrs.

Age (yr.)	Girls	Girls Weight (Actual weight)								
		P3	P5	P10	P25	P50	P75	P90	P95	P97
12	88	25.1	25.4	27.4	31.4	36.6	41.9	50.7	52.2	53.8
12.5	96	24.5	28.2	29	32.45	37.65	46	56.3	60.8	67
13	104	26.3	27.5	30.2	34.5	40.35	48.45	54.8	57	68.9
13.5	119	29.6	30.9	33.5	38.1	41.9	47.5	51.1	63.3	64.1
14	132	29	31.7	34.5	37.5	42.55	49.65	54.7	61.1	66.8
14.5	78	32	33.9	36.2	41	44.55	49.9	54.4	60.8	77.3
15	66	31	32.7	36.4	40	45.55	51	53.5	59.7	61.3
15.5	84	35.4	36	38.2	40.85	46.55	53.65	58.8	64	70
16	98	36	37.5	38.7	41.9	47.1	53.4	58.6	66.1	73.5
16.5	83	36.8	37.4	38.8	42	46.8	53.2	60	63.5	66.2
17	90	35.2	36.3	38.15	39.7	45.3	51.3	53.95	59.8	68.5

P= percentile

Table 18: Smoothed Weight for age for Girls (in Kgs).

Age	Girls	Girls Weight (Smoothed Weight)*								
		P3	P5	P10	P25	P50	P75	P90	P95	P97
12	88	24.32	25.71	27.3	31.19	36.51	43.11	52.61	54.73	58.38
12.5	96	25.51	27.27	29.14	33.09	38.25	45.2	53.32	57.22	62.55
13	104	26.86	28.78	30.99	35.03	39.99	46.99	53.63	59.15	65.61
13.5	119	28.35	30.31	32.82	36.88	41.63	48.38	53.76	60.56	67.48
14	132	29.82	31.78	34.47	38.46	43.11	49.56	54.16	61.35	68.75
14.5	78	31.31	33.13	35.85	39.73	44.43	50.64	54.87	61.86	69.42
15	66	32.78	34.35	36.95	40.59	45.51	51.66	55.86	62.44	69.34
15.5	84	34.21	35.52	37.8	41.12	46.24	52.47	56.96	63.11	69.4
16	98	35.32	36.43	38.36	41.34	46.56	52.83	57.58	63.34	69.35
16.5	83	36.01	36.97	38.63	41.19	46.49	52.74	57.44	62.8	68.85
17	90	36.39	37.26	38.75	40.78	46.18	52.37	56.65	61.74	68.29

- **Smoothed using Cubic Spline technique.**

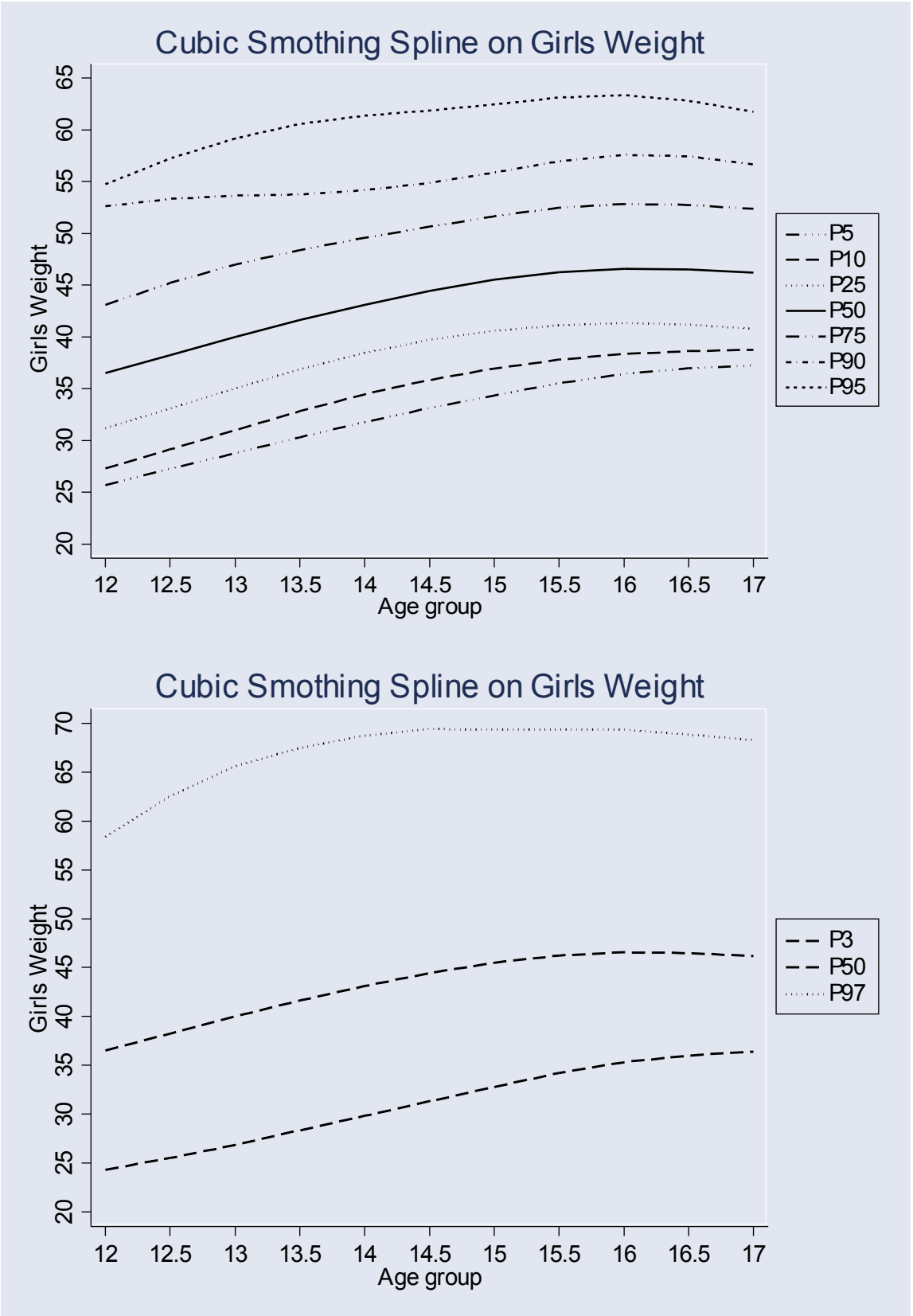


Fig 9 and 10: 3rd, 5th, 10th, 25th, 50th, 75th, 90th, 95th, 97th smooth centile curves: Weight for age for Girls from 12 to 17 years.

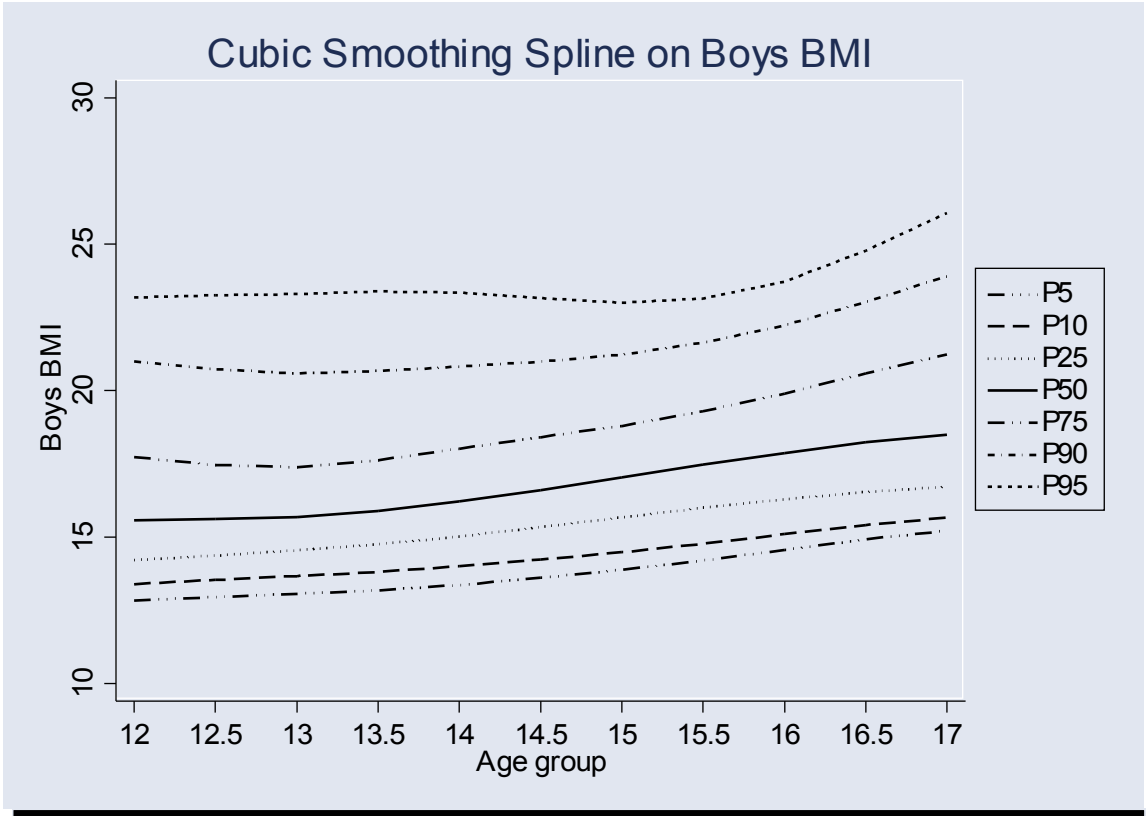
Table19: Observed BMI for age for boys from 12 to 17 years.

Age	Boys	Boys BMI (Actual BMI)								
		P3	P5	P10	P25	P50	P75	P85	P95	P97
12	72	11.94	12.81	13.29	14.28	15.79	18.56	20.42	22.86	23.54
12.5	95	12.86	12.96	13.73	14.33	15.62	16.94	19.68	24.35	28.9
13	92	12.73	13.41	13.79	14.67	15.5	16.57	17.99	21.43	24.34
13.5	95	12.6	12.79	13.53	14.59	15.67	17.33	18.95	24.52	26.38
14	119	13.03	13.15	13.91	14.84	16.23	18.95	20.04	23.91	24.21
14.5	102	13.65	14.08	14.47	15.55	16.71	18.74	20.16	23.81	25.66
15	75	13.68	13.69	14.4	15.44	16.91	18.3	19.65	21.99	22.83
15.5	67	13.37	13.95	14.6	16.31	17.71	19.33	20.41	23.23	26.22
16	81	14.11	14.55	14.94	15.91	17.57	19.22	20.21	22.44	23.83
16.5	63	14.52	15.44	16.05	17.2	18.86	21.57	23.52	24.88	30.15
17	99	14.5	14.95	15.34	16.35	18.13	20.95	22.5	26.93	30.15

P=percentile

Table 20: Smoothed BMI for age for Boys for age 12 to 17 years.

Age	Boys	Boys BMI (Predicted BMI)*								
		P3	P5	P10	P25	P50	P75	P85	P95	P97
12	72	12.18	12.83	13.39	14.21	15.58	17.73	19.91	23.18	25.41
12.5	95	12.46	12.95	13.54	14.37	15.61	17.46	19.46	23.26	25.71
13	92	12.68	13.06	13.67	14.55	15.69	17.39	19.16	23.3	25.63
13.5	95	12.89	13.18	13.81	14.75	15.89	17.62	19.17	23.39	25.33
14	119	13.12	13.36	14	15.02	16.21	18.02	19.39	23.35	24.92
14.5	102	13.36	13.61	14.23	15.34	16.61	18.41	19.68	23.16	24.65
15	75	13.57	13.88	14.48	15.67	17.04	18.8	20.03	23	24.68
15.5	67	13.79	14.2	14.77	16	17.47	19.3	20.54	23.15	25.28
16	81	14.05	14.56	15.1	16.29	17.87	19.9	21.24	23.73	26.45
16.5	63	14.32	14.92	15.41	16.54	18.23	20.59	22.08	24.78	28.15
17	99	14.58	15.22	15.66	16.72	18.5	21.24	22.88	26.07	30



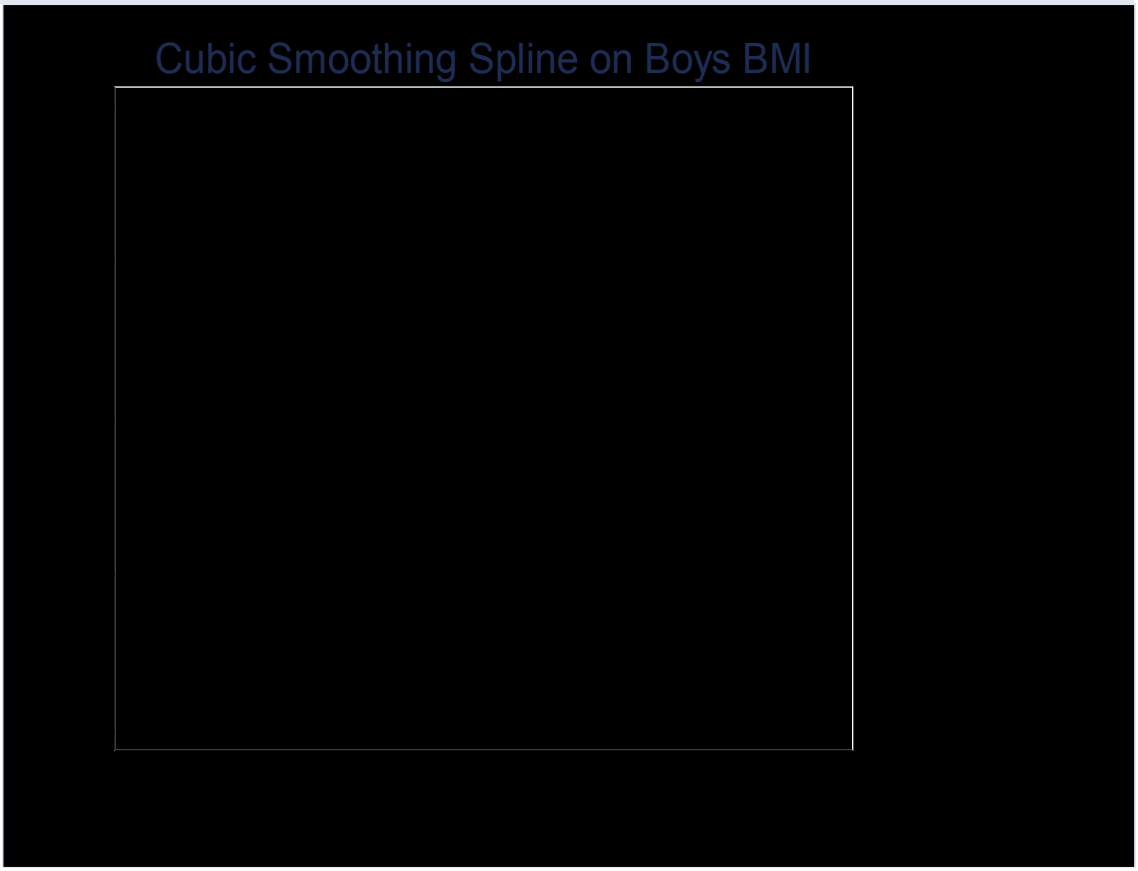


Fig 11 and 12: 5th,10th,25th,5oth,75th, 85th,90th,95th centile curves for BMI for age for boys

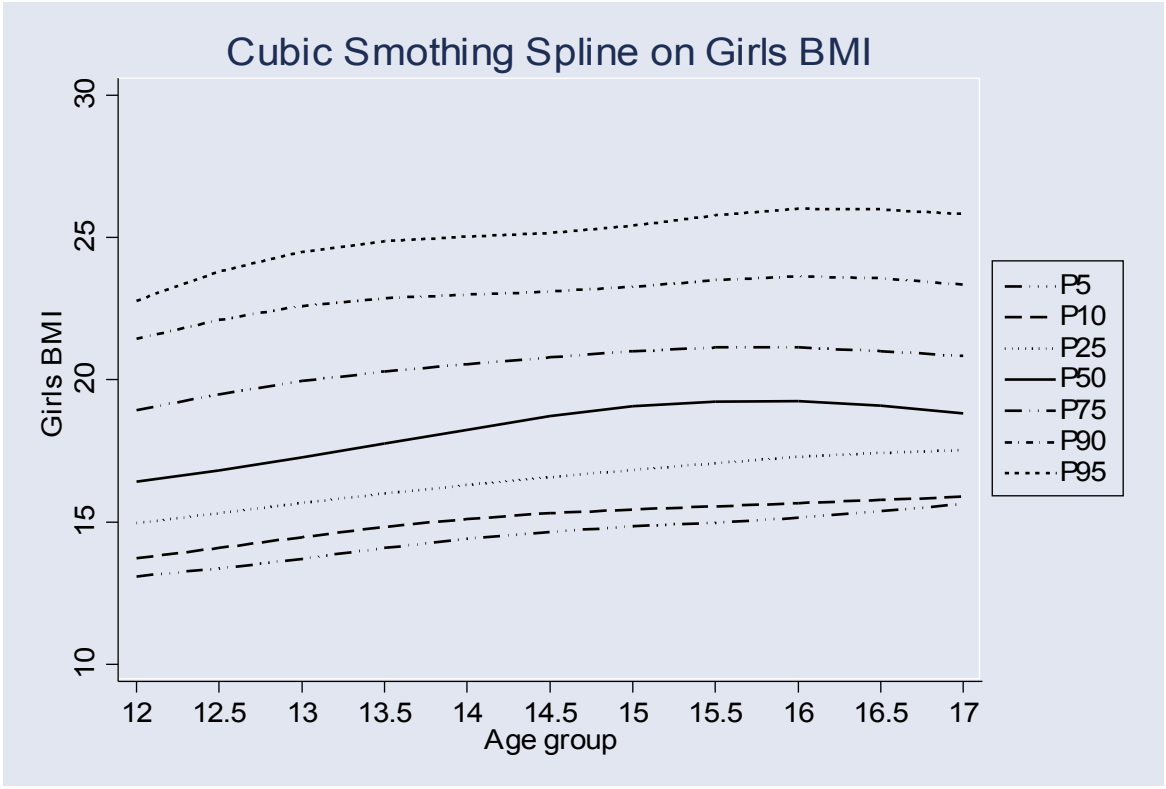
Table 21: Observed BMI for age for Girls from 12 to 17 years.

Age	Girls	Girls BMI (Actual BMI)								
		P3	P5	P10	P25	P50	P75	P85	P95	P97
12	88	13.15	13.33	13.8	15.01	16.62	18.58	20.04	21.3	25.2
12.5	96	12.85	13.13	13.89	15.09	16.53	19.61	21.91	25.69	26.1
13	104	12.68	13.18	14.34	15.89	17.37	20.5	22.39	24.38	28
13.5	119	14.08	14.67	15.08	15.99	17.54	20.22	22.31	25.31	27.8
14	132	14.07	14.37	15.16	16.1	18.01	20.24	21.73	24.79	28.9
14.5	78	13.76	14.69	15.43	17.01	19.03	20.62	22.21	24.98	31
15	66	14.39	15.15	15.32	16.44	19.34	21	22.37	23.64	25.3
15.5	84	14.28	14.79	15.55	16.96	18.92	21.51	22.42	27.01	29.3
16	98	14.34	14.8	15.62	17.59	19.69	21.1	23.08	26.67	30.2
16.5	83	15.15	15.51	15.72	17.59	19.23	21.18	22.9	26.1	28.4
17	90	15.27	15.7	15.94	17.29	18.39	20.55	21.69	25.28	28.1

Table 22: Smoothed BMI for age for Girls from 12 to 17 years.

Age	Girls	Girls BMI (Predicted BMI)*								
		P3	P5	P10	P25	P50	P75	P85	P95	P97
12	88	12.89	13.09	13.72	14.96	16.42	18.93	20.73	22.78	25.43
12.5	96	13.05	13.37	14.09	15.31	16.82	19.49	21.39	23.81	26.44
13	104	13.27	13.71	14.47	15.67	17.27	19.96	21.86	24.49	27.38
13.5	119	13.56	14.09	14.83	16	17.75	20.29	22.12	24.87	28.11
14	132	13.81	14.41	15.11	16.3	18.25	20.55	22.24	25.03	28.59
14.5	78	14.01	14.66	15.31	16.58	18.73	20.79	22.35	25.16	28.77
15	66	14.2	14.85	15.44	16.83	19.07	21	22.47	25.41	28.72
15.5	84	14.39	14.98	15.55	17.07	19.24	21.13	22.58	25.78	28.8
16	98	14.64	15.15	15.66	17.29	19.25	21.13	22.61	26.01	28.84
16.5	83	14.94	15.38	15.77	17.43	19.08	21.01	22.48	25.99	28.69
17	90	15.25	15.63	15.9	17.52	18.81	20.83	22.22	25.82	28.44

***Smoothed using Cubic Spline technique.**



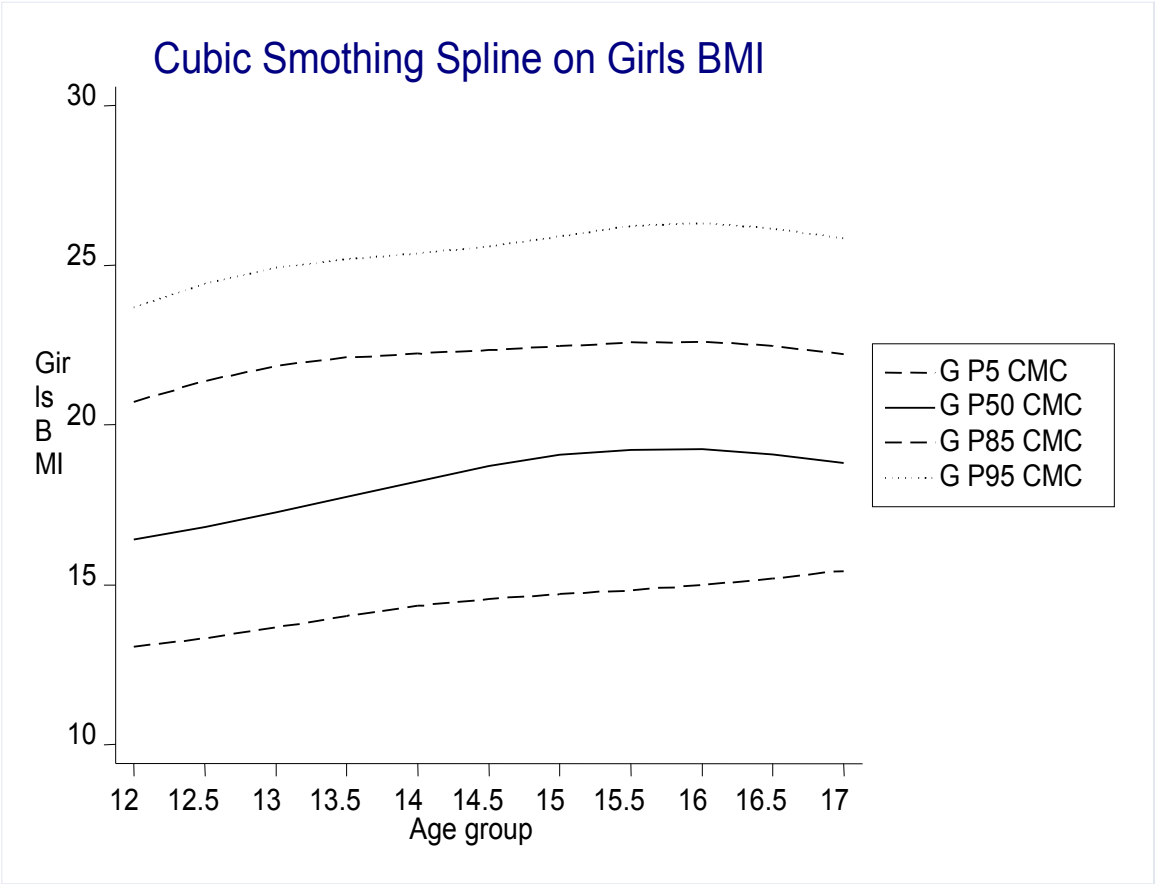


Fig 13 and 14:5th,10th,25th,50th,75th,85th,90th,95th centile charts of BMI for age for girls

Comparison of Height for age centile curves for boys and girls:

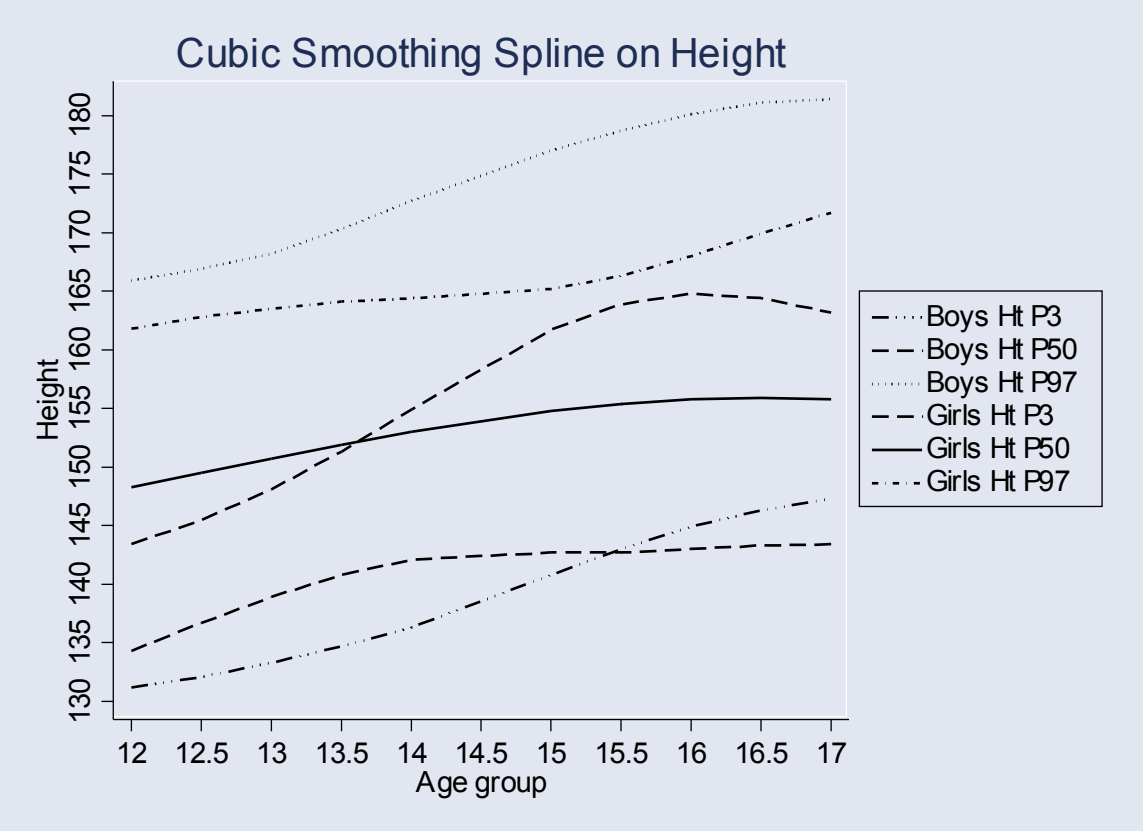


Fig 15: Comparison of 3rd,50th,97th centile for height for age for boys and girls

During 12 to 13.5 years of age girls have a higher mean height as compared to boys of the same age on the 50th centile and after 14 years of age boys are taller. In 3rd centile the girls were found to be taller till 15.5 years after which boys gain weight and in 97th centile boys are taller throughout.

Comparison of Weight for age centile curves for boys and girls:

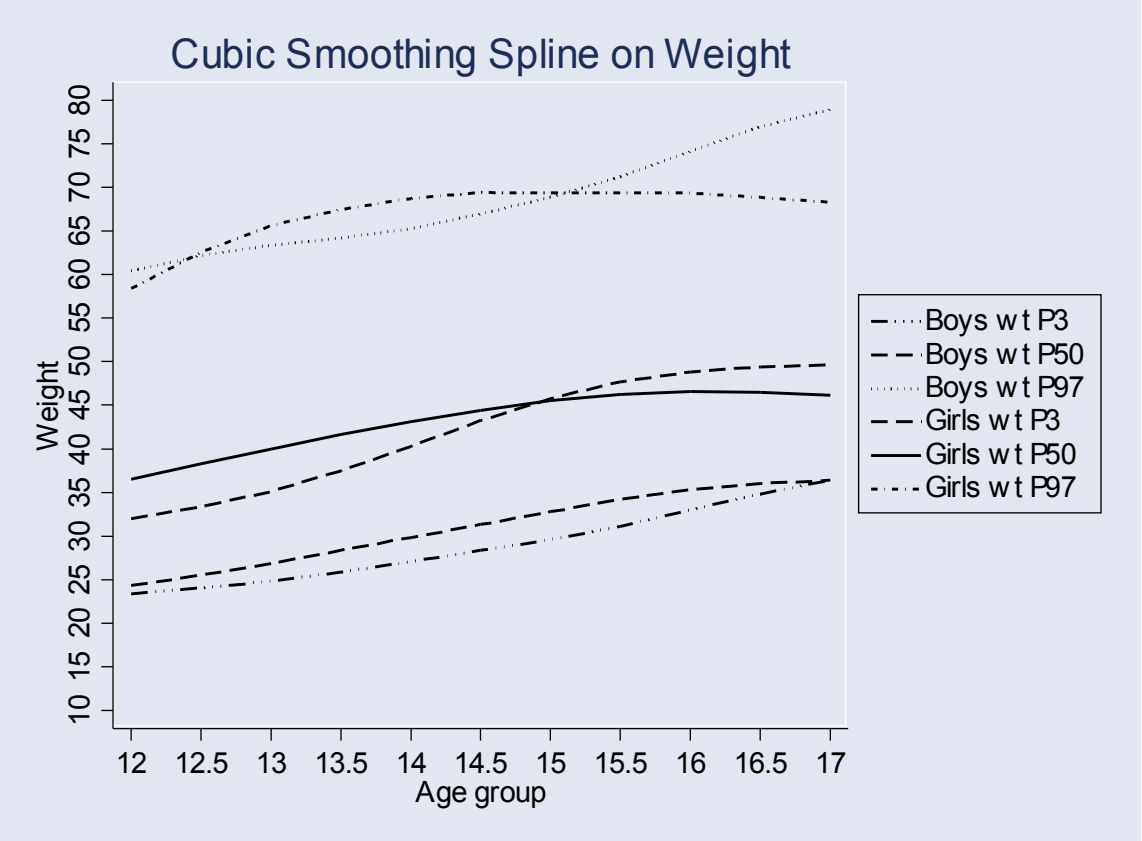


Fig 16: Comparison of 3rd,50th,97th centile for weight for age for boys and girls

In our study girls were found to be taller as compared to boys in 3rd percentile were as in the 50th percentile girls were found to taller till 15 years of age and subsequently boys were taller. In 97th percentile also the boys gain height after 15 years and remain taller

Comparison of BMI for age for boys and girls:

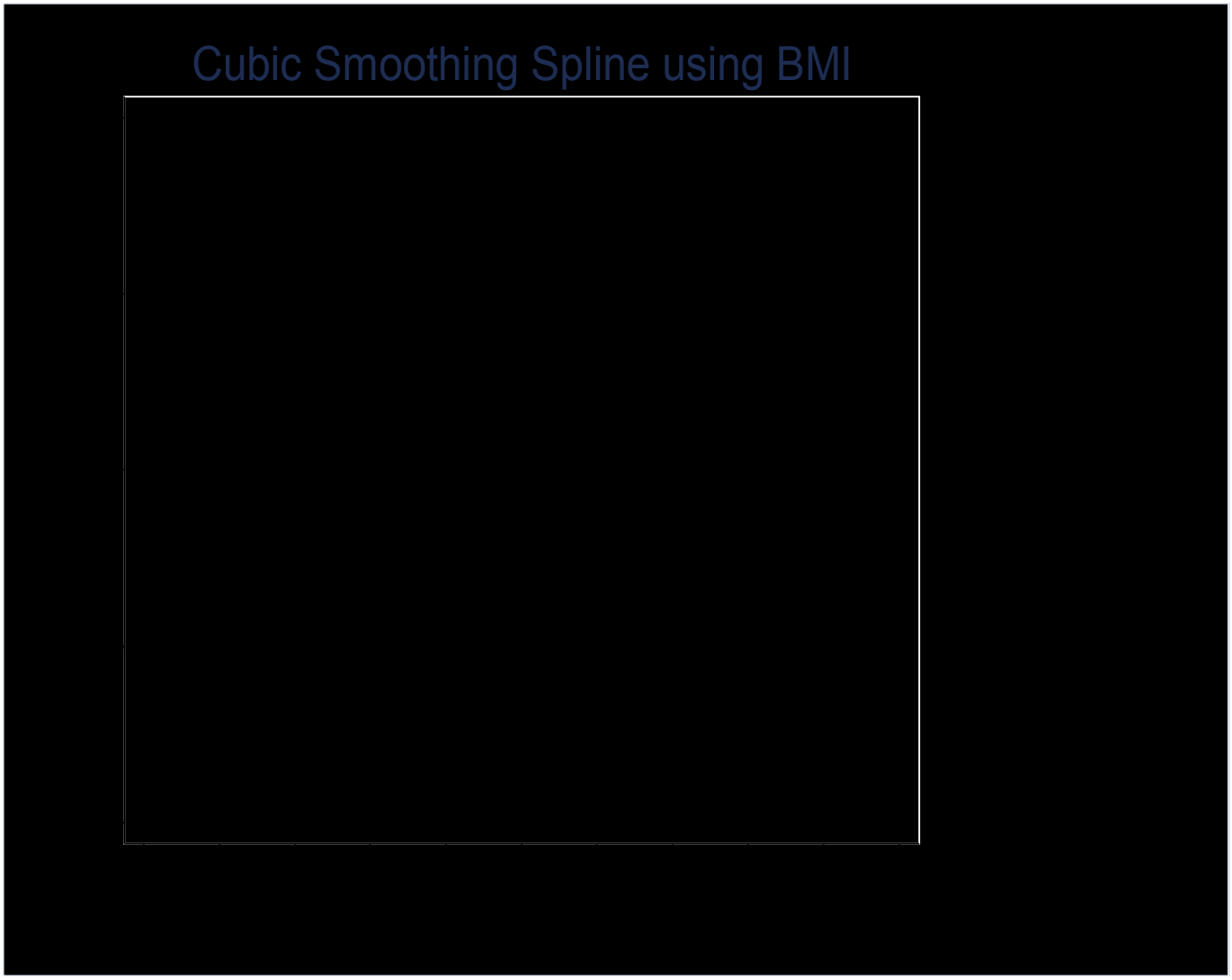


Fig 17 : Comparison of 5th,50th,95th, centile curves of BMI for age for boys and girls

Boys were found to have lesser BMI than girls in 5th, 50th, 80th, 85th and 95th percentile. In 85th and 95th percentile boys were found to have more BMI after 16.5 years of age.

Comparison of percentile heights with Indian upper Socio-Economic Boys:

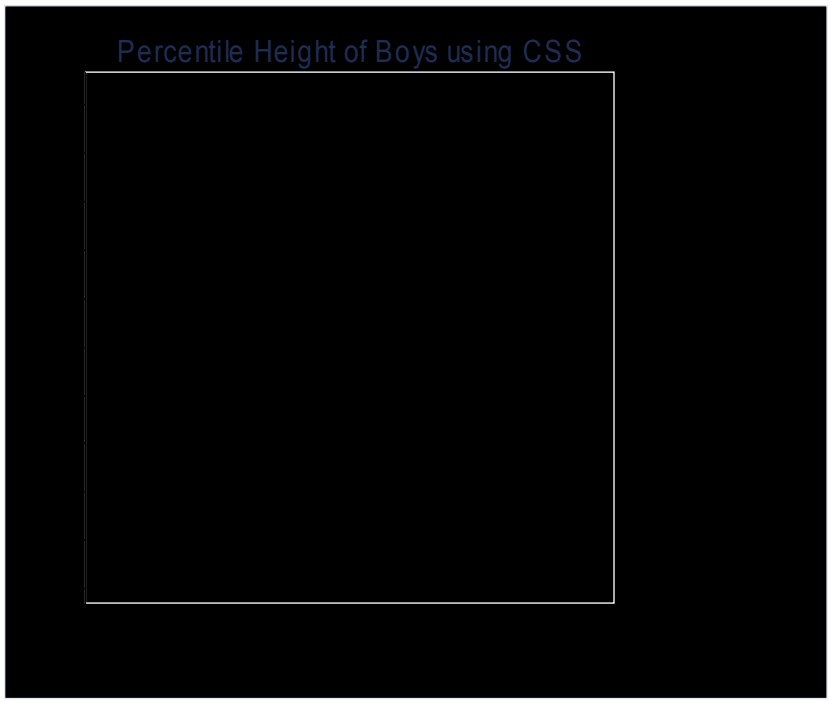


Fig 18:Comparison of 3rd,50th,97th cebtile curves of height for age for boys with Agarwal data

Age										
12										
12.5										
13										
13.5										
14										
14.5										
15										
15.5										
16	153.6	146.5	154.9	151	157.9	154.5	166.3	167.5	179.8	178
16.5	156.6	147	157.4	147	159.4	148	167.7	164	180.7	186
17	159.6	146	159.8	149	161.5	151	168.7	161	181.2	178.5

Table 23: Comparison of present study and Agarwal percentiles: Height for age for boys

The data of boys in the present study as compared to Agarwal data for height for age are presented in Table 24. On the 3rd centile data of present study boys are shorter by 1 to 6 cm till 13 years of age and ultimately boys are shorter by 13 cm at 17 years of age as compared to the Agarwal study.

On the 50th centile data of present study boys are shorter by 1 to 6 cm till 14 years of age and ultimately boys are shorter by 7 cm at 17 years of age as compared to the Agarwal study. On the 97th centile data of present study boys are taller by 1 to 7 cm till 15 years of age and ultimately boys are shorter by 2.5 cm at 17 years of age as compared to the Agarwal study.

Comparison of percentile heights with Indian upper Socio-Economic Girls:

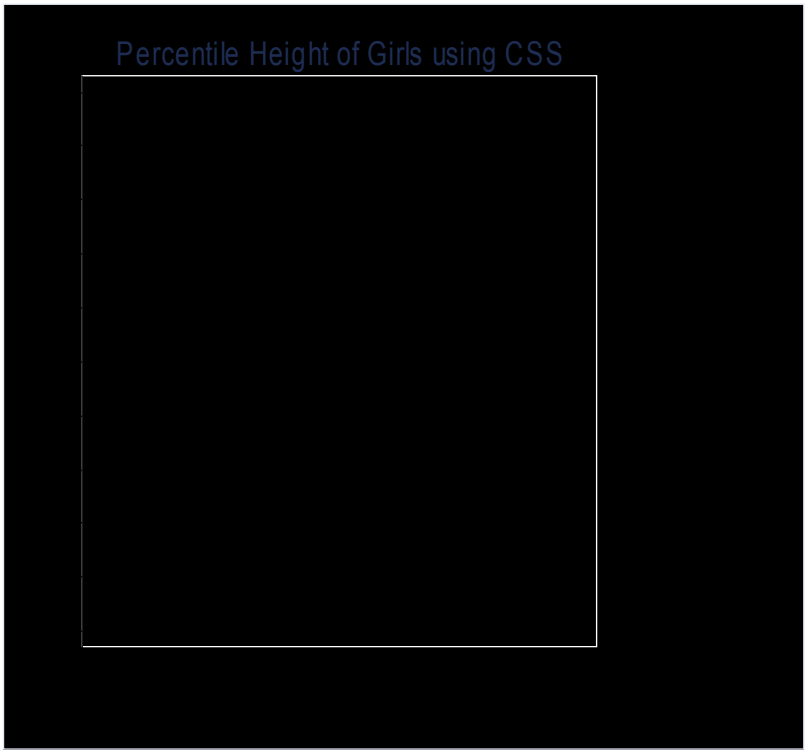


Fig19: Comparison of 3rd,50th,97th, centile curves of height for age for girls with Agarwal data.

Age	Percentile height for age for girls									
	P3		P5		P10		P50		P97	
	Agar	PS	Agar	PS	Agar	PS	Agar	PS	Agar	PS
12	133.9	134	135	136.5	137.4	137.5	146	148.2	158.5	161
12.5	136.3	136	137.5	136	139.8	140.5	148.3	149.7	160.4	164
13	138.5	139	139.8	139.5	142.1	141.5	150.4	150	162.1	162
13.5	140.6	141	141.9	141.5	144.1	145	152.2	152	163.5	167
14	142.4	144	143.8	145	145.9	147	153.8	153.5	164.7	164
14.5	144.4	139	145.4	144.5	147.4	146.5	155.1	153.9	165.8	163
15	145.5	143	146.6	144	148.6	148	156	154.8	166.5	165
15.5	146.6	144	147.5	147	149.3	148.5	156.6	156	167.1	168
16	147.5	143	148	147.5	149.7	149	156.8	156.7	167.4	168
16.5	148	145	148.1	146.9	149.7	148.4	156.5	156.5	167.6	172
17	148.3	142.6	148.5	146	149.8	147.7	157	155	168	171

Table 24: Comparison of present study and Agarwal percentiles: Height for age for girls.

The data of girls in the present study as compared to Agarwal data for height for age for girls are presented in Table 24. On the 3rd centile data of present study girls are similar till 14 years of age and ultimately girls are shorter by 6 cm at 17 years of age as compared to the Agarwal study. On the 50th centile data of present study girls are taller by 2 cm at 12 years of age and ultimately girls are shorter by 2 cm at 17 years of age as compared to the Agarwal study. On the 97th centile data of present study girls are taller by 2 to 4cm till 14 years of age and ultimately girls are taller by 3 cm at 17 years of age as compared to the Agarwal study.

Comparison of percentile Weight with Indian upper Socio-Economic boys:

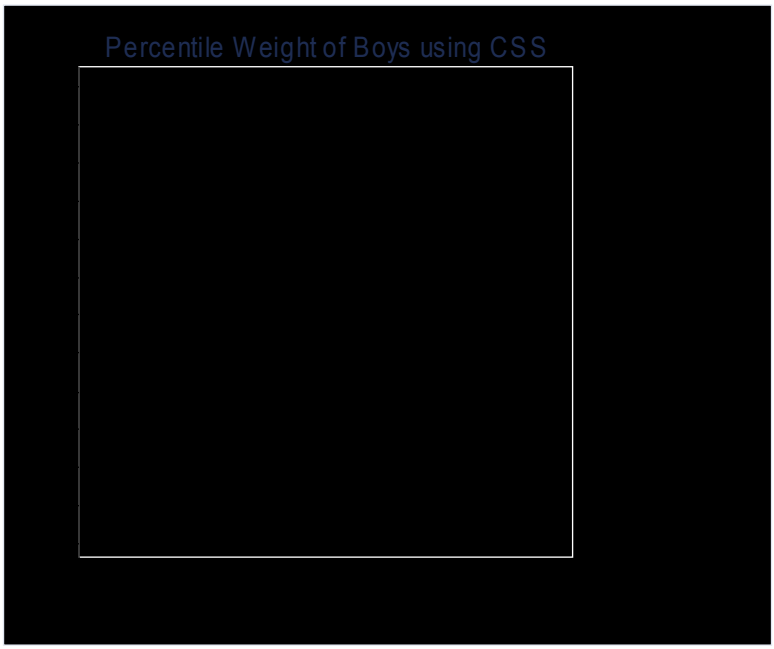


Fig 20: Comparison of 3rd,50th,97th centile curves of weight for age for boys with Agarwal data.

Age	Percentiles weight for boys									
	P3		P5		P10		P50		P97	
	Agar	PS	Agar	PS	Agar	PS	Agar	PS	Agar	PS
12	25.3	24.3	26.3	24.5	27.9	27.2	34.8	33.3	54.1	57.7
12.5	26.7	22.9	27.8	24	29.6	26.9	37.1	33	57.1	66.5
13	28.1	25.1	29.3	25.9	31.3	27.2	39.4	33.5	60.0	63.1
13.5	29.6	25.4	31.0	27.3	33.1	27.9	41.8	36.7	63.0	66.5
14	31.2	26.7	32.7	26.9	34.9	30	44.1	39.8	65.9	57.5
14.5	32.9	27.8	34.5	32.3	36.7	35.7	46.3	49.7	68.7	69.3

15	34.6	30.5	36.3	31.5	38.6	33.7	48.6	44.75	71.4	73.3
15.5	36.5	29.1	38.1	30.4	40.3	33.2	50.5	45.1	73.9	67
16	38.5	34.4	40.0	35.3	42.1	38.2	52.4	48.9	76.3	70.5
16.5	40.6	37.2	41.9	38.1	43.8	40	54.0	49.6	78.5	87
17	42.8	35	43.9	36.2	45.9	38.5	55.5	48.5	80.5	74.2

Table 25: Comparison of Present study and Agarwal percentiles: Weight for age for boys.

The data of boys in the present study as compared to Agarwal data for weight for age are presented in Table 25. On both 3rd and 50th centile data of present study boys have lower weight by 1 to 7 kg till 17 years of age as compared to the Agarwal study. On the 97th centile data of present study boys are heavier by 3 to 9 kg till 13 years of age and ultimately boys have lower weight by 6 kg at 17 years of age as compared to the present study.

Comparison of percentile Weight with Indian upper Socio-Economic Girls:

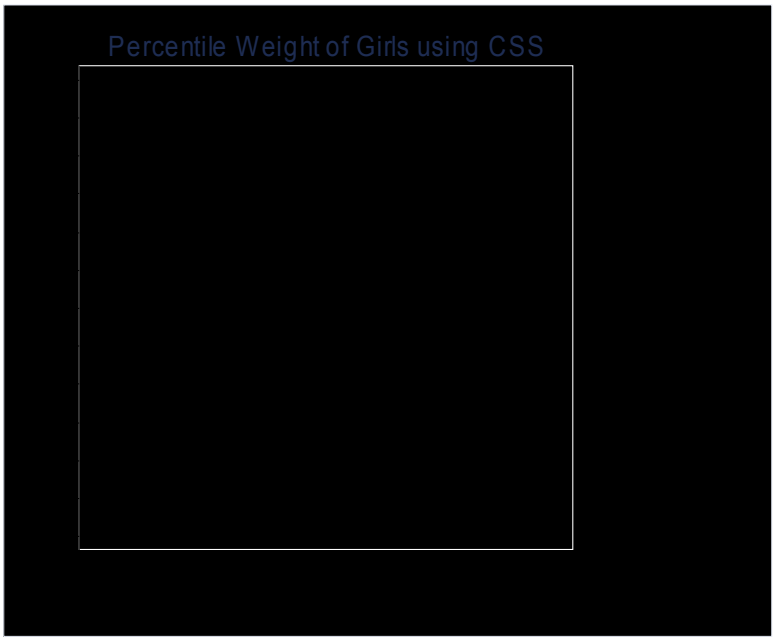


Fig 21: Comparison of 3rs,50th,97th centile curves of weight for age for girls with

Age	Percentile Weight for girls									
	P3		P5		P10		P50		P97	
	Agar	PS	Agar	PS	Agar	PS	Agar	PS	Agar	PS
12	25.1	25.1	25.6	25.4	27.3	27.4	35.0	36.6	55.1	53.8
12.5	26.5	24.5	27.2	28.2	29.0	29	37.1	37.65	57.9	67
13	27.9	26.3	28.9	27.5	30.7	30.2	39.1	40.35	60.7	68.9
13.5	29.3	29.6	30.6	30.9	32.4	33.5	41.0	41.9	63.2	64.1
14	30.7	29	32.1	31.7	34.0	34.5	42.7	42.55	65.7	66.8
14.5	32.1	35.4	33.6	36	35.5	38.2	44.3	46.55	67.9	70
15	33.4	32	35.0	33.9	36.9	36.2	45.7	44.55	70.0	77.3
15.5	34.6	31	36.2	32.7	38.2	36.4	46.8	45.55	71.8	61.3
16	35.7	36	37.3	37.5	39.3	38.7	47.7	47.1	73.3	73.5
16.5	36.7	36.8	38.1	37.4	40.1	38.8	48.2	46.8	74.6	66.2
17	37.6	35.2	38.7	36.3	40.7	38.15	48.4	45.3	75.6	68.5

Table 26: Comparison of Present study and Agarwal percentiles: Weight for age for girls.

The data of girls in the present study as compared to Agarwal data for weight are presented in Table 26. On the 3rd centile data of present study girls are having lower weight by 1 to 3 kg till 17 years

of age as compared to Agarwal study. On the 50th centile data of present study girls are heavier by 1 to 2 kg till 15 years of age and ultimately girls have lower weight by 3 kg at 17 years of age as compared to Agarwal study. On the 97th centile data of present study girls are heavier by 2 to 10 kg till 15 years of age and ultimately girls have lower weight by 3 kg at 17 years of age as compared to Agarwal study.

Comparison of CDC growth chart with present study:

Height for age for boys and girls:

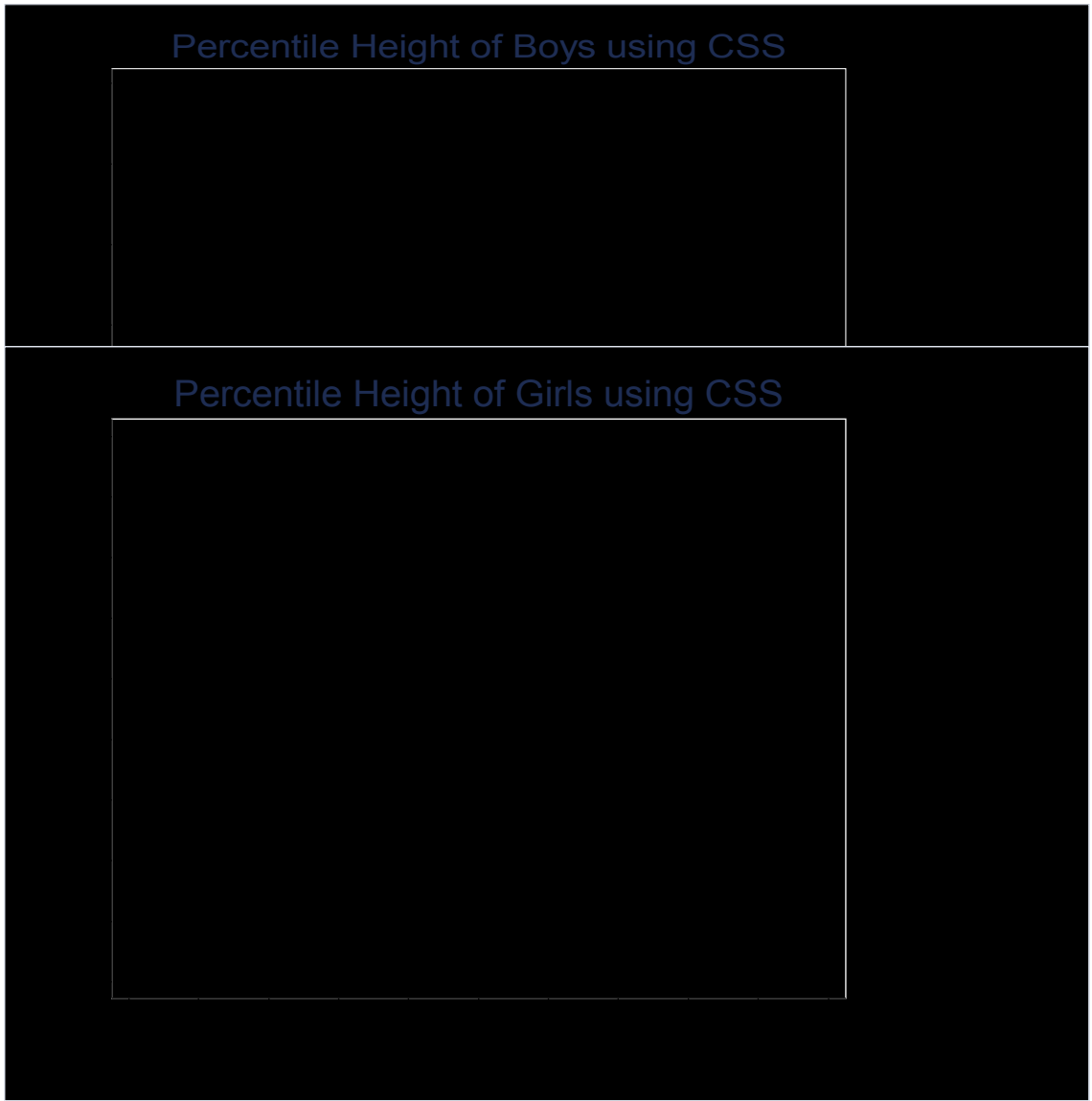


Fig 22 and 23: Comparison of 3rd, 50th, 97th, centile curves of height for age for boys and girls with CDC data.

Comparing our height for age centiles for boys with CDC curves it was found that our 3rd centile was much lower than CDC 3rd centile and our 50th centile was in between their 3rd and 50th centile. We also found that our 97th centile was initially higher between 12.5 years but after that CDC curves were much higher. We also found that all three height for age centiles for girls were much lower than the CDC percentile curves.

Weight for age for boys and girls:

All three centiles were much lower in both boys and girls when compared with CDC growth curves.

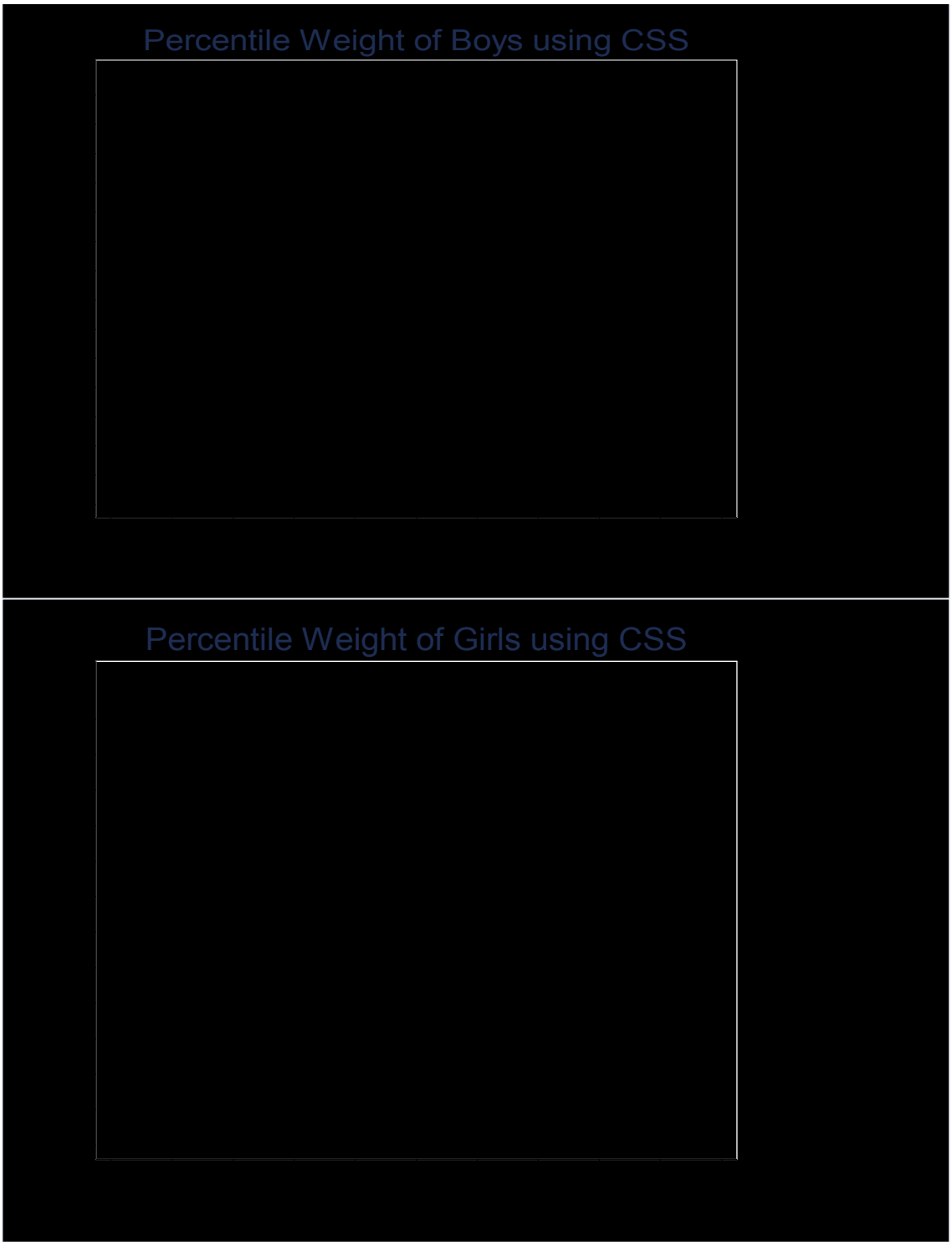
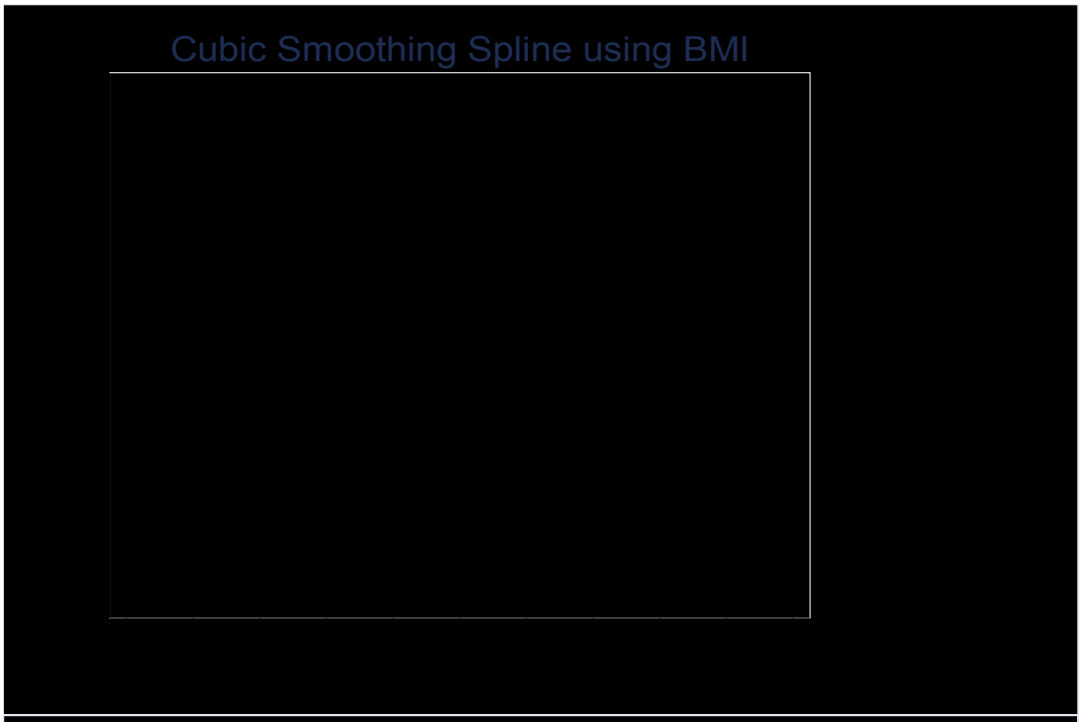
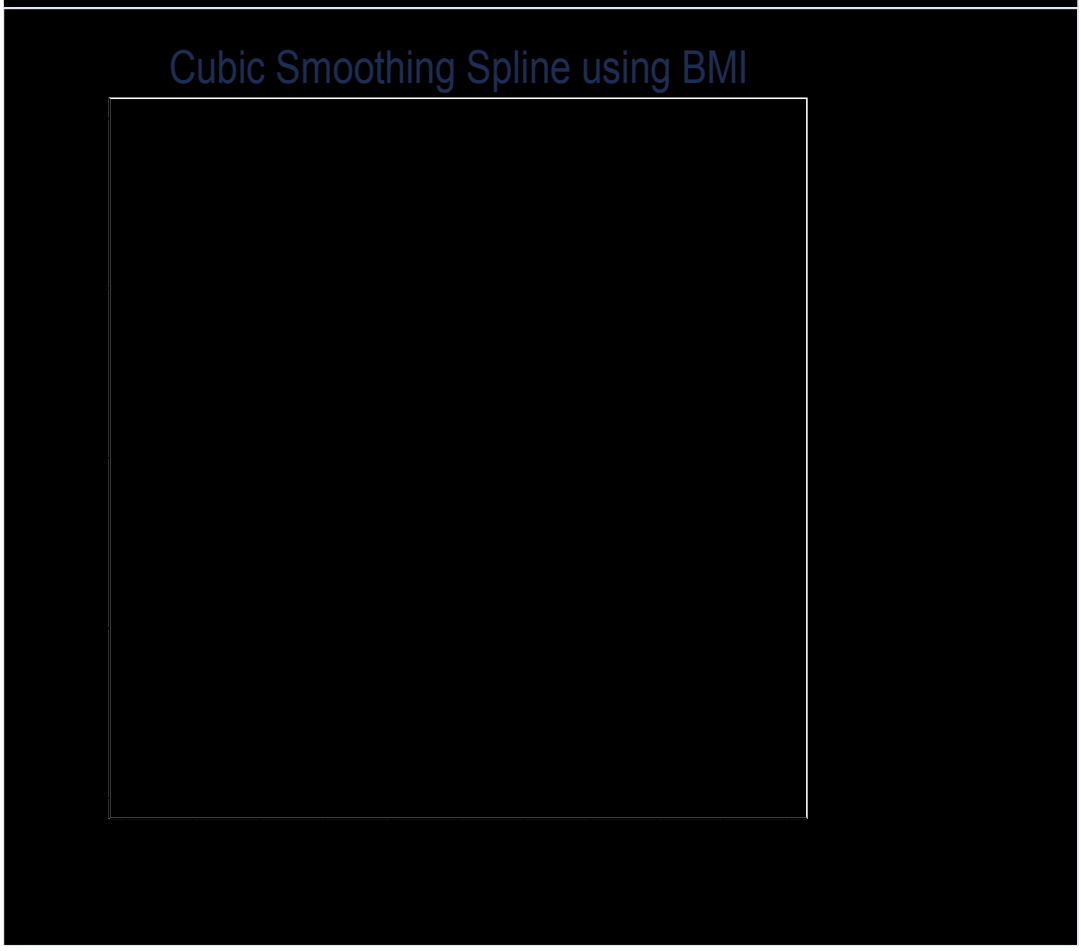


Fig 24 and 25: Comparison of 3rd, 50th,97th centile curves of weight for age for boys and girls with CDC data

BMI for age for boys and girls:

It was found that our 5th, 50th, 85th,and 95th centiles were much lower than CDC growth curves in both boys and girls.





RESULTS FOR SEXUAL AND MENSTRUAL AWARENESS

No	Knowledge questions	SEX		
		Boys (%) N=127	**Girls** (%) N=139	**P value**
1.	Safe sexual practices, good personal and menstrual hygiene can prevent STD (yes)*	109(85.8)	105(75.5)	.044
2.	Self-genital stimulation is normal. (yes)	51(40.2)	64(46.0)	.386
3.	The spread of HIV can be controlled by the correct and regular use of condoms. (yes)	96(75.6)	102(73.4)	.779
4.	A STD can spread from a woman to man but not from a man to woman.(no)	57(44.9)	54(38.8)	.323
5.	HIV is transmitted through - Tattoo - Sharing common needles	 3(2.4) 102(80.3)	 3(2.2) 130(93.5)	 1.00 .002
6.	In which part of the female reproductive system does the baby grow - Uterus	59(46.5)	118(84.9)	.000
7.	In which part of female reproductive system does the sperm and ovum unite - Fallopian tube	37(29.1)	46(33.1)	.510

The correct responses are marked with in brackets.

No	Attitude questions	SEX		
		Boys(%) N=127	**Girls**(%) N=139	**P value**
1.	It is all right for a male to have sexual experience before marriage (disagree)	94 (74.0)	121(87.1)	.008
2.	Occasional visits to commercial sex workers is accepted (disagree)	75(59.1)	66(47.5)	.066
3.	Sex education in schools is not advisable as it may induce increased sexual activity (disagree)	44(34.6)	41(29.5)	.430
4.	An unmarried girl can be allowed to gather information about safe sex (agree)	100(78.7)	96(69.1)	.094

5.	Condoms should be made available to unmarried people also (agree)	49(38.6)	14(10.1)	.000
6.	Condom usage always prevents sexually transmitted diseases (disagree)	17(13.4)	6(4.3)	.015
7.	Having advertisements about condoms on TV and radio can spoil young children(disagree)	55(43.3)	45(32.4)	.076
8.	A person with HIV should be isolated in society.(disagree)	70(55.1)	96(69.1)	.023
9.	A HIV infected person should inform is/her partner.(agree)	37(29.1)	26(18.7)	.527
10	While travelling in a bus if you suspect that the person sitting next to you is HIV positive, you will move to another seat.(disagree)	76(59.8)	110(79.1)	.001
11	HIV positive people should not be given any jobs.(disagree)	98(77.2)	113(81.3)	.450

Table 27: Sexual Awareness questions: In boys and girls

No	**Knowledge questions**	**Medium**		
		English (%) N=179	**Tamil** (%) N=87	**P value**
1.	Safe sexual practices, good personal and menstrual hygiene can prevent STD (yes)*	109(85.8)	105(75.5)	.044
2.	Self-genital stimulation is normal. (yes)	51(40.2)	64(46.0)	.386
3.	The spread of HIV can be controlled by the correct and regular use of condoms. (yes)	96(75.6)	102(73.4)	.779
4.	A STD can spread from a woman to man but not from a man to woman.(no)	57(44.9)	54(38.8)	.323
5.	HIV is transmitted through - Tattoo - Sharing common needles	 3(2.4) 102(80.3)	 3(2.2) 130(93.5)	 1.00 .002
6.	In which part of the female reproductive system does the baby grow - Uterus	59(46.5)	118(84.9)	.000
7.	In which part of female reproductive system does the sperm and ovum unite - Fallopian tube	37(29.1)	46(33.1)	.510

- The correct responses are marked with in brackets

No	Attitude questions	Medium		
		English (%) N=179	Tamil (%) N=87	P value
1.	It is all right for a male to have sexual experience before marriage (disagree)*	148 (82.7)	67(77)	.319
2.	Occasional visits to commercial sex workers is accepted (disagree)	106 (59.2)	35 (40.2)	.004
3.	Sex education in schools is not advisable as it may induce increased sexual activity (disagree)	62 (34.6)	23 (26.4)	.208
4.	An unmarried girl can be allowed to gather information about safe sex (agree)	148 (82.7)	48 (55.2)	.000
5.	Condoms should be made available to unmarried people also (agree)	46 (25.7)	17(19.5)	.286
6.	Condom usage always prevents sexually transmitted diseases (disagree)	18(10.1)	5(5.7)	.352
7.	Having advertisements about condoms on TV and radio can spoil young children (disagree)	70(39.1)	30(34.5)	.502
8.	A person with HIV should be isolated in society.(disagree)	110 (61.5)	56 (64.4)	.687
9.	A HIV infected person should inform is/her partner.(agree)	153 (85.5)	65 (74.7)	.041
10	While travelling in a bus if you suspect that the person sitting next to you is HIV positive, you will move to another seat.(disagree)	143 (79.9)	43 (49.4)	.000
11	HIV positive people should not be given any jobs.(disagree)	150 (83.8)	61 (70.1)	.15

Table 28:Sexual awareness Questions: In English and Tamil medium schools

Fig 28:Sex Vs Score

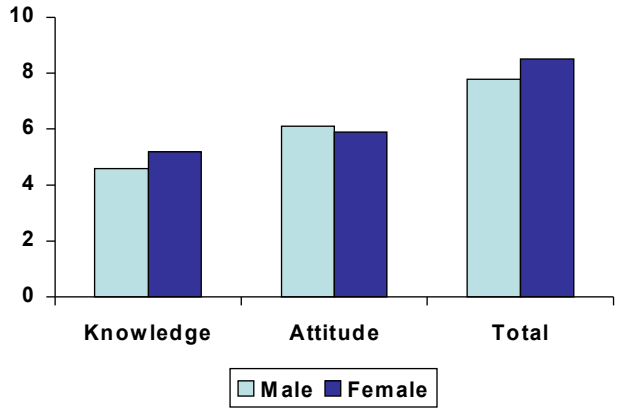


Table 29: Independent T test for total, knowledge and attitude scores* Vs sex

Scores	Sex	Mean	S.D	Independent t test P value
Total scores	**Male**	7.7953	3.99869	.119
	Female	8.5036	3.38876	
Knowledge scores	**Male**	4.5591	1.64584	.006
	Female	5.1655	1.87120	
Attitude scores	**Male**	6.1417	2.12216	.385
	Female	5.9281	1.88295	

*Knowledge and attitude scores include only positive scores and total scores include both positive and negative scores

Fig 30:Medium Vs Score

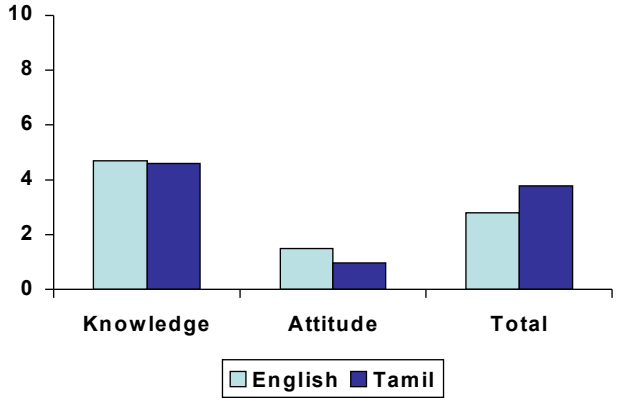


Table 30: Independent T test for total, knowledge and attitude scores* Vs medium

Scores	Medium	Mean	S.D	Independent t test P value
Total scores	English	9.1061	3.53075	.000
	Tamil	6.2299	3.28740	
Knowledge scores	English	5.5978	1.49726	.000
	Tamil	3.3908	1.38393	
Attitude scores	English	6.4469	1.71288	.000
	Tamil	5.1724	2.26812	

*Knowledge and attitude scores include only positive scores and total scores include both positive and negative scores

Sexual Awareness:

139 girls (52.2%) and 127 boys (47.7%) were included in the study. 179 (67.3%) belonged to English medium schools and 87 (32.7%) belonged to Tamil medium schools.

Knowledge Questions:

It included on Questions on knowledge about reproduction, contraception, HIV, and Sexually transmitted diseases.

Reproduction:

Only 118 (84.9%) respondents in girls and 59 (46.5%) in boys were aware that the baby grows in the uterus. Similarly only 46 (33.1% girls and 37 (29.1%) boys were aware that the sperm and ovum unite in fallopian tubes. However there was no difference between the medium of education in answering the first question and significantly the English medium students {80 (44.4%)} were better aware about the process of fertilization as compared to Tamil medium students {3(3.4%)} with a significant P value (.000).

Awareness about STD and HIV:

The awareness about condom and HIV prevention was similar in both boys {96(75.6)} and girls {(10273.4%)}. Girls were more aware that HIV could be transmitted through sharing needles than boys {130(93.5%) and 102 (80.3%) respectively} and awareness about tattoo being a cause of HIV transmission was poor in both gender. Similarly the English medium children were better aware about the usefulness of condom in prevention of HIV as compared to Tamil medium children {151 (84.4%) and 47 (54%) respectively}. The awareness about sharing common needles being a cause of HIV transmission was better among English medium children {168(93.9%)} as compared to Tamil medium children {64(73.6%)}.

Knowledge Score:

Girls had a better knowledge score (Mean – 5.16) as compared to boys (Mean – 4.55) which was statistically significant (P value <. 001). The mean knowledge scores were more in English medium (5.59) as compared to Tamil medium children (3.39) with a significant p value (<. 001).

Attitude Questions:

It included questions on premarital sex, sex education, contraception, HIV, and STD.

Sexual relations:

Significantly 121 (87.1%) girls disagreed that it is all right for a male to have sexual experience before marriage as compared to only 94 (74%) boys with a significant p value (.008). Similarly only 75 (59.1%) of boys and 66 (47.5%) girls felt occasional visits to CSW were unacceptable. Significantly the English medium children had a better awareness with relation to premarital sexual experience and occasional visits to CSW.

Sex Education and Safe Sex Information:

Only 44 (34.6%) boys and 41 (29.5%) girls felt that sex education does not induce increased sexual activity. However 100 (78.7%) boys and 96 (69.1%) girls agreed that unmarried girls could be allowed to gather information about safe sex. Similarly English medium children had no taboo with regard to unmarried girl gathering information about safe sex, however only 62 (34.6%) English medium children and 23 (26.4%) Tamil medium children felt that sex education in schools would not induce increased sexual activity.

Attitude towards condoms:

Only 49(38.6%) boys and 14 (10.1%) girls agreed that condoms should be made available to unmarried people. 17 (13.4%) boys and 6 (4.3%) girls answered that condom usage does not always prevent STD. 55(43.3%) boys and 45 (32.4%) girls felt that advertisements about condoms in TV and radio does not spoil children.

Attitude towards HIV:

96 (69.1%) girls were against isolating patients with HIV as compared to 70 (55.1%) boys. Only 37 (29.1%) boys and 26 (18.7%) girls agreed that an HIV infected person should inform is/her partner. Similarly 113 (81.3%) girls were against HIV patients being denied a job as compared to 98 (77.2%) boys. Similarly more girls {110(79.1%)} were against HIV patients being treated unfairly in the buses as compared to boys {76 (59.8%)}.

Attitude score:

Boys had a better attitude score (Mean – 6.14) as compared to girls (Mean – 5.92) ; this was not statistically significant. The mean attitude score was more in English medium (6.44) as compared to Tamil medium children (5.17) with a significant p value (<. 001).

Total score:

Girls had better total score (mean – 8.50) as compared to boys (mean – 7.79) which was not statistically significant. The mean total score was more in English medium (9.1) as compared to Tamil medium children (6.22) with a significant p value (<. 001)

RESULTS OF MENSTRUAL AWARENESS

Menstrual awareness questionnaire:

No	Knowledge questions	Medium		
		English (%) N=100	**Tamil** (%) N=39	**P value**
1.	Pain associated with periods is normal (Agree)*	70(70)	23(59)	.233
2.	Sanitary napkins/cloth should be changed frequently during periods (Agree)	93(93)	37(94.9)	1.00
3.	If a woman does not menstruate once a month her blood can become bad. (Disagree)	13 (13)	7(17.9)	.435

4.	The occurrence of menstruation at normal intervals for a woman is an indication that the woman is not pregnant. (Agree)	67(67)	16(41)	.007
5.	Women continue to have monthly periods till about 50 years of age (Agree)	59(59)	19(48.7)	.342
6.	Onset of menstruation indicates that the girl can become pregnant (Agree)	34 (34)	16(41)	.440
7.	Fertilization of the ovum by the sperm occurs following sexual intercourse (Agree)	65(65)	16(41)	.013
8.	A girl can get pregnant if she had sex just once (Agree)	28(28)	15(38.5)	.307
9.	Girls are emotionally and physically not mature enough to get married soon after menarche (Agree)	41(41)	32(82.1)	.000

* The correct responses are marked with in brackets

No	**Attitude questions**	**Medium**		
		English (%) N=100	Tamil (%) N=39	P value
1.	A girl should stop her studies after she starts her periods (disagree)*	97(97)	35 (89.7)	.097
2.	Menstruating girls should not be allowed into prayer room. (disagree)	50 (50)	5 (12.8)	.000

* The correct responses are marked with in brackets

Table 30: Menstrual Awareness Questionaire:

The questionnaire includes questions on age of onset of menarche, source of information, menstrual hygiene, and practices regarding menstruation.

.

Fig 30:Medium Vs Score

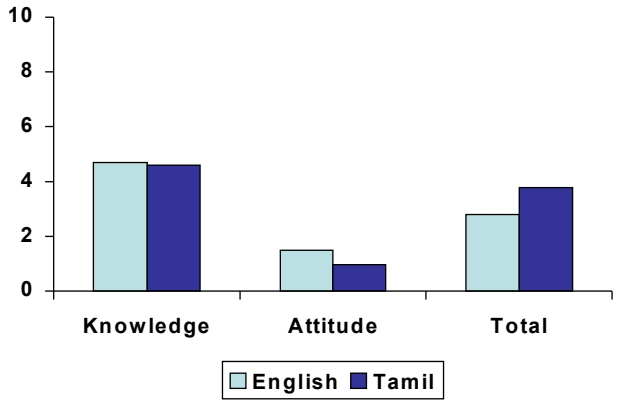


Table 31:Independent T test for total, knowledge and attitude scores* Vs medium

Scores	Medium	Mean	S.D	Independent t test P value
Knowledge scores	English	4.7000	1.96690	.879
	Tamil	4.6410	2.21819	
Attitude scores	English	1.4700	0.54039	.000
	Tamil	1.0256	0.48597	
Total scores	English	2.8400	2.08273	.046
	Tamil	3.7692	3.19919	

* Knowledge and attitude scores include only positive scores and total scores include both positive and negative scores

Age of onset of Menarche

124 (89.2%) of girls said that the age of onset of menarche was between 11 –15 yr. 1 (0.7%) said less than 11 years, 8 (5.8%) said more than 15 years and 6(4.3%) did not. Know.

Source of information:

Mother was the main source of information about menstruation in both English medium (90%) and Tamil medium (84.6%) school children. The second most common source of information was from friends in both English (80%) and Tamil medium (23.9%) school children and the difference was statistically significant. In English medium schools more children learnt regarding menstruation from books ($p <. 001$), sister ($p <. 001$) and school (<. 001) as compared to Tamil medium school and the difference was statistically significant.

Who do they approach for sexual problems:

Mother was preferred for discussing sex-related problems among both English medium (84%) and Tamil medium children (56.4%). Girls studying in English medium schools (62%) also preferred their friend's more as compared to girls from Tamil medium schools (15.4%) and the difference was statistically significant.

Knowledge Questions:

Both girls from English (93%) and Tamil (94.9%) medium felt that sanitary napkins should be changed frequently. However, more girls from Tamil medium felt that girls are emotionally and physically not mature to get married soon after menarche than English medium girls.

Knowledge score:

Both English and Tamil medium children had comparable mean scores (4.70 and 4.6 respectively) but was not statically significant.

Attitude Questions:

No entry in prayer room by menstruating girls was practiced more among girls from English medium (97%) than girls from Tamil medium schools (89.7%) and the difference was statistically significant. 97% of girls from English medium and 89.7% of girls from Tamil medium felt that a girl should stop her studies after attaining menarche.

Attitude scores:

The mean attitude was more in English medium (1.47) as compared to Tamil medium children (1.02) with a significant p value (<. 001).

Total Score:

The mean total score in Tamil medium (3.76) as compared to English (2.84) medium children and the p value was .046

Discussion

Although many studies have been conducted on the anthropometry assessment of nutritional status in preschool children, much less such information can be found about adolescent children. Among the

most important reasons for this lack of information is the difficulty of interpreting anthropometric data in these age groups.

The results show that the mean height of boys are comparable to Agarwal data [8] till 16.5 years of age were there is a dip. This could be explained by less number of children in that age. As shown in fig (18) the median height curve for boys was comparable to Agarwal height curve till 14 years of age after which there is a dip, which is probably due to less number of children in that age were as in Agarwal study the sample sizes ranged from 300 to 900 in each class interval. The mean heights of girls were comparable to Agarwal weights. The 50^{th} and 97^{th} percentile height curve for girls in our study was comparable to Agarwal height curve were as the 3^{rd} percentile curve was comparable till 14 years of age after which there is a dip explained by the same cause.

Weight for age percentile curves for boys and girls were comparable to Agarwal study[8] in 3^{rd} and 50^{th} percentile were as it was comparable to 97^{th} percentile till 14.5 years of age after which there is a dip due to the same reason (fig 20 and 21). The reasons could be, that Agarwal study was done among affluent children whereas our study population was a mix of rural and town children. Also the sample size in Agarwal study was more.

When compared with CDC growth curves, height and weight percentile curves for boys and girls were much lower (fig 22 – 25). These differences may be probably due to a combination of nutritional, genetic and environmental influences in growth during early childhood[84].

In the Agarwal comparison was made with NCHS 1978 and was found that the Agarwal data showed less weight as compared to the NCHS data. The height was lower at all points with a mean difference of 5 to 6 cm when compared with NCHS data[8].

When we compared the BMI for age for both boys and girls of our study with CDC we found that all

percentiles especially 5th, 85th,and 95th percentile curves were much lower. (Fig 26,27) This could mean that if CDC charts were used in our population we would actually overestimate prevalence of thinness, and underestimate obesity. This would actually lead referrals to hospitals and in turn increase the cost burden of the patients.

We also found a positive correlation of parents education with height and weight of adolescent children which was statistically proven by multiple linear regression analysis.

In our study children were not equally representative, this may be because only school going children were included in the study. In a developing country like India were poverty and anemia are still prevalent were school education is compulsory upto 5th standard only. So education is given only to affordable average SES and there is more chance of girls discontinuing education. We also need a larger sample size in view of the wide variation in the socio economic and cultural difference in the population. Majority belong to lower socio-economic group and their dietary food is deficient in protein .This also shows the importance of having region based reference charts.

Sexual Awareness:

In our study girls were found to have better knowledge about reproduction than boys and English medium students were more aware of the process of fertilization as compared to Tamil medium students with a significant p value. Only 50% of respondents believed that self-genital stimulation was normal as compared to a study done on adolescent boys were 90% of the total respondents opined that masturbation was not a healthy practice in the study[87]. Similar study done among adolescents girls showed that 80% of them were unaware and only 20% were aware about masturbation [85].

26% of boys and 22.9% of girls believed that males could have sexual experiences before marriage as compared to 19.1% boys and 5.1% girls justified premarital sex in study conducted in Jammu Kashmir[86] . 59.1% of boys and 47.5% of girls accept that occasional visits to commercial sexual worker are all right. 75.6% of boys and 73.4% of girls were aware about use of condom in protecting from HIV and only 17% of boys and 4.3% girls were aware that condoms does not always protect you from STD. In a study done on adolescent boys in Bombay done in 2001 only 20.8% knew about use of condoms and 19.2% were totally unaware about any preventive measure against HIV [87]. Only 38.6% of boys and 10.1% of girls had a positive attitude towards making condoms available to unmarried people and this difference was statistically significant. 43.3% boys and 32.4% girls were in favour of showing advertisements about condom in the media. In a focus discussion in Jamaican adolescent study[88], adolescent boys and girls frequently mentioned that the condom and the pill as appropriate methods for young people and volunteered that these contraceptives should be made available from doctors, health centers and pharmacies.

Regarding awareness about routes of transmission of HIV 93.5% girls and 80.3% boys stated sharing needles as the cause and, awareness about tatooing as a cause of HIV transmission was very limited were as only 38.33% were aware about infected blood, and sharing needles as a route of transmission in another study[87]. The awareness about routes of transmission of HIV was better among English medium children than Tamil medium children. In our study more girls were against isolating HIV patient's as compared to boys, similarly more girls were against HIV patients being unfairly treated in buses and were in favour of giving jobs to HIV patients. But only 29.1% of boys and 18.7% of girls were in favour of HIV patients informing the partner.

In our study only 1/3 of girls and boys believed that sex education in schools does not induce increase

in sexual activity, whereas in a study done on 75 adolescent girls, 80% had a positive attitude and 20% had negative attitude towards sex education [85].

The English medium school children were found to have better knowledge and attitude score which was statistically significant by independent t test.

Overall the knowledge about routes of spread of HIV, use of condoms was good. Most children seemed to share a positive attitude towards HIV patients. Majority were against sex education in school. A similar study conducted by Jasmine Prasad et al at the Community Health Department, Christian Medical College, Vellore also concluded that the knowledge on menstrual hygiene, contraception and safe sex practices was poor and stressed the importance of sex education of adolescents. The knowledge was fairly alright, however there seem to be knowledge gap which needs to be addressed.

Menstrual Awareness:

Majority of the girls (89.2%) were aware of age of onset of menarche. In our study mothers, friends, and books were the main source of information. The English medium children (84%) preferred mothers, friends and for discussing problems related to sex than Tamil medium children (56.4%) the difference was statistically significant (p value <.001).

64.5% of girls felt that pain associated with menses was normal as compared to study done in Tehran were 48.5% said it was a disease or made no comment about it [89]. 93.9% of girls in our study were aware of maintaining hygienic practices including frequent changing of sanitary napkins. Only 37.5% of girls were aware that onset of menstruation indicates the girl can become pregnant and only 54% of girls were aware that occurrence of regular periods indicate women is not pregnant. In our study 2/3rd

of the children did not know that pregnancy was possible at first intercourse which was comparable to Jamaican adolescent study [88].

84.5% of girls believed that failure to menstruate monthly can make the blood bad. In our study 31.4 % of girls said that girls should not be allowed to enter the prayer room as compared to 93 % of girls were not allowed to enter the prayer room in a study conducted in Himachal Pradesh[90]. Similarly 93.4% were against discontinuing studies after menarche.

Majority of the girls was aware about menstrual hygiene. They strongly were against discontinuing studies after attaining menarche. However they continued to have misconceptions and were willing to follow ancient practices, which were probably related to religious belief.

CONCLUSIONS

1. The mean height and weight of girls were more than boys upto 13.5 years but later boys gain weight and height beyond 14 years, which is probably due to earlier puberty in girls.
2. Our anthropometry indices of boys and girls are comparable to Agarwal study till 14 years of age.
3. The anthropometric indices of boys and girls are much lower when compared with CDC.
4. Knowledge about sexual awareness was more among girls.
5. Knowledge and attitude about sexual awareness was more among English medium boys and girls.
6. The English medium girls had a better attitude towards menarche.

LIMITATIONS

1. The study does not have good community representation as only school going children were included in the study.
2. Age groups 15.5 yr. and 16.5 yr. for boys & 15 yr. for girls had less than required number of children.
3. There was inadequate representation from Tamil medium school in the menstrual awareness study.

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APPENDIX 1- Sexual Awareness Questions

	Knowledge Questions	Yes	Not sure	no
1.	Safe sexual practices, good personal and menstrual hygiene can prevent sexual transmitted diseases			
2.	Self-genital stimulation is normal.			
3.	The spread of HIV can be controlled by the correct and regular use of condoms.			
4.	A sexually transmitted disease can spread from a woman to man but not from a man to woman			

	Attitude Questions	Agree	Not sure	Disagree
5.	It is alright for a male to have sexual experience before marriage			
6	Occasional visits to the commercial sex workers are acceptable			
7	Sex education in schools is not advisable as it may induce increased sexual activity			
8	An unmarried girl can be allowed to gather information about safe sex			
9	Condoms should be made available to unmarried people also			
10	Condom usage always prevents sexually transmitted diseases			
11	Having advertisements about condoms on TV and radio can spoil young children			
12	A person with HIV should be isolated in society			
13	A HIV infected person should inform is/her partner			
14	While travelling in a bus if you suspect that the person sitting next to you is HIV positive, you will move to another seat			
15	HIV positive people should not be given any jobs.			

16. HIV is transmitted through

a) Mosquito, b) tattooing, c) Kissing, d) Hugging/Shaking hands, e) Sharing common needles

17.The following is not a risk factor for getting HIV
a)Having sex with a commercial worker b) Having multiple sexual partners
c) Using unsterile needles for injections d) Smoking

18. In which part of the female reproductive system does the baby grow?
a) Uterus, b) cervix, c) Fallopian tubes, d) Ovary.

19. In which part of female reproductive system dos the sperm and ovum unite?
a) Vagina, b) uterus, c) Fallopian tube, d) Ovary

APPENDIX 2- Menstrual Awareness questionnaire

	Knowledge Questions	Yes	Not sure	No
1.	Pain associated with periods is normal			
2.	Sanitary napkins/cloth should be changed frequently during periods			
3.	If a woman does not menstruate once a month her blood can become bad.			
4.	The occurrence of menstruation at normal intervals for a woman is an indication that the woman is not pregnant.			
5.	Women continue to have monthly periods till about 50 years of age			
6.	Onset of menstruation indicates that the girl can become pregnant			
7.	Fertilization of the ovum by the sperm occurs following sexual intercourse			
8	A girl can get pregnant if she had sex just once			
9.	Girls are emotionally and physically not mature enough to get married soon after menarche			

11. Did you learn about menstruation from (yes or no)

1) Friends …….
2) Father …….
3) Mother …….
4) Books …….
5) Sister …….
6) School …….
7) Others …….

12.If there is a problem related to sexuality I will approach my yes or no

1) Mom …….
2) Dad …….
3) Teacher …….
4) Peers …….
5) Friends …….
6. Others …….

14. What is the age of onset of Menarche?

	Attitude Questions	agree	Not sure	disagree
15	A girl should stop her studies after she starts her periods			
16	Menstruating girls should not be allowed into prayer room.			